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READINGS IN TECHNOLOGY ASSESSMENT

Selections from the Publications of the Program of Policy Studies in Science and Technology

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READINGS IN TECHNOLOGY ASSESSMENT

Selections from the Publications
of the Program of Policy Studies
in Science and Technology

September 1975

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Brief notations about the authors are listed at the end of the volume following the selections.

I. INTRODUCTION

READINGS IN TECHNOLOGY ASSESSMENT

Selections from the Publications of the Program of Policy Studies in Science and Technology

I. INTRODUCTION

In 1966 The George Washington University made a deliberate institutional decision to inquire into the means by which the knowledge and analytical resources of a major university in the Nation's Capital might be usefully related to the on-going public policy process while simultaneously strengthening the research and instructional programs of the university. A generous institutional grant from NASA enabled the University to establish the Program of Policy Studies in Science and Technology which was to be applied to the development of "a university policy analysis capability."

The Program of Policy Studies is an interdisciplinary, University-wide policy analysis group. The Program has a core staff of full-time professional researchers representing a wide range of disciplines. The Program draws on the resources of the University faculty, graduate and professional students and research facilities. The Program's special strength is the capability to assemble and manage interdisciplinary analysis groups. Continuing relationships are maintained with the governmental agencies, professional associations, and other private sector representatives in the Washington area.

The Program has taken an active interest in all areas of Science, Technology, and Public Policy. Members of the staff have had an early, intense, and continuing interest in the development of Tech-

nology Assessment concepts and methodologies. This aspect of policy studies is especially appropriate since Technology Assessment involves an interdisciplinary analytical process designed to provide decision makers with information on the total social implications of proposed programs and projects.

The Program produced approximately 40 publications relating to Technology Assessment during the period of the NASA award. These studies explore the historical, theoretical, methodological, and institutional aspects of assessment. Many of these publications represent early efforts to probe the concept and methodologies of the assessment function. They have served, along with the contributions of many other institutions and scholars, to acquaint a generation of technology assessment practitioners--both graduate students and policy makers--with the process of technology assessment.

This volume has two purposes. The first is to republish, in whole or in part, PPS technology assessment publications still in demand but now out of print. The second is to publish in one volume some of the Program's more significant assessment studies. With these objectives in mind, the papers selected for this volume are organized to reflect the Program's research in the following areas: development of the concept of technology assessment; institutionalization of technology assessment; the interface between law and technology assessment; and assessment case studies.

II. DEVELOPMENT OF THE CONCEPT OF TECHNOLOGY ASSESSMENT

Technology assessment is not one clearly defined analytical technique. Quite the contrary. It embodies several essential proc-

esses: problem definition, data gathering, analysis of alternatives, and policy implementation. However, the assessment procedure will vary with the task-objective given or posited, including such variables as the nature of the technological project configuration to be assessed with respect to defined social environments.

The Program's publications on the development of the concept of technology assessment reflect a variety of conceptual facets.

Kranzberg's paper, Historical Aspects of Technology Assessment, indicates that current concepts of technology assessment and efforts to institutionalize the assessment function clearly have antecedents in the events and decisionmaking sequences of the past. The excerpts from Coates's larger study, Technology and Public Policy: The Process of Technology Assessment in the Federal Government, summarize the basis of early legislative concern for establishing a legislative technology assessment component to aid in public decisionmaking.

The Technology Assessment task must confront the interacting variables--conditions and trends--of an evolving social process. Contextual factors are obviously of great relevance to the definition of the relevant problem situation. These topics and others are discussed in Mayo's paper, The Contextual Approach to Technology Assessment: Implications for 'One-Factor Fix' Solutions to Complex Social Problems. It is an obvious fact that we have attempted to solve, alleviate, or somehow cope with intricate social problems by totally inadequate "single factor" means whether the latter be legal, economic, or technological. The contextual approach undertakes to demonstrate that technology assessment assists in the identification

of the full range of implications of taking a particular action and, in addition, facilitates the consideration of alternative means by which the total affected social problem context might be changed by available project options.

The paper by Black, Technology Assessment: What Should It Be? provides a special perspective on the technology assessment function. It stresses the necessity of uncovering unsuspected relationships in proposed actions, and treats the feasibility of using decision theoretical models to cope with problems of uncertainty in the future-oriented analyses characteristic of assessments. Mayo's paper on Social Impact Evaluation sets forth an anticipatory assessment construct which emphasizes the importance of concepts and standards of "social justice" or schemes of social value weight and distribution in performance of the assessment task.

The Program's publications have also reflected another aspect of conceptual development, i.e., refinement of the methodology of technology assessment. Jones's paper, Generating Social Impact Scenarios: A Key Step in Making Technology Assessment Studies, summarizes a methodology developed by the Mitre Corporation for the Office of Science and Technology. This paper was presented in a seminar series the Program conducted on technology assessment. The conceptual and methodological importance of doing retrospective technology assessments is summarized in the research proposal: Retrospective Technology Assessment: Submarine Telegraphy.

III. INSTITUTIONALIZATION OF TECHNOLOGY ASSESSMENT

The Program's papers and reports on the institutionalization of technology assessment represent several different perspectives and levels of analysis. They include examination of the institutionalization of technology assessment in the legislative and executive branches of the Federal government and in State government. The important issue of public participation has also been addressed.

Drawing upon teaching, governmental and policy analysis experience, Mayo prepared a detailed analysis for the Congress of the relationships between an institutionalized assessment function and legislative information gathering and decisionmaking needs. This is reprinted as: Some Legal, Jurisdictional, and Operational Implications of a Congressional Technology Assessment Component.

Mayo's paper on Some Implications of the Technology Assessment Function for the Effective Public Decisionmaking Process undertakes to analyze ways in which the institutionalization of the assessment function can affect the following phases of the public decision process: problem perception, problem definition, data assembly, invention of alternatives, evaluation of options, authorization, implementation, operation, appraisal, and modification.

Presented next are excerpts from one of the Program's studies on the implementation of technology assessment, or the use of technology assessment information in decisionmaking. This study was prepared by Kasper, Logsdon and Mottur and titled: Implementing Technology Assessments: Final Report of the Technology Assessment Implementation Project.

Reprinted in its entirety is Coates's Summary Report: Technology

and Public Policy: The Process of Technology Assessment in the Federal Government. This review covers the following topics: 1) who is doing technology assessment, 2) organization of technology assessments, 3) disciplines and techniques used in technology assessment, 4) analysis of a sample of technology assessment studies, 5) gaps and overlaps in federal technology assessment, 6) prerequisites for further improvement of governmental technology assessment.

As part of its four-part program to develop priorities for technology assessment research both for its own support program and for the congressional Office of Technology Assessment, the National Science Foundation awarded a grant to the Program to prepare a statement on technology assessment priorities in the Executive branch. Excerpts from the Program's report include: "Candidates and Priorities for Technology Assessments: A survey of Federal Executive Agency Professionals."

Executive and legislative staff in State governments have expressed keen interest in using technology assessment to improve decisionmaking. In 1974 the Program staff participated in a conference on this topic. Excerpts are taken from the report: The Southern Regional Conference on Technology Assessment.

Coates has followed closely the origin and evolution of the congressional Office of Technology Assessment. Her first evaluation of the Office's performance is reprinted as: Emerging Trends in Technology Assessment.

A considerable body of research has been devoted to examining the role of the public in technology assessment. Two foci are apparent. One relates to using citizen's opinions, attitudes, and

reactions to technology as data for the conduct of the assessment process--that is, to use this information to estimate the social impacts of technology. Another research focus examines the effort to enhance the power base of the public in implementaing the results of a technology assessment. The Program's research has addressed both of these topics. Selections come from: Mottur's paper on Technology Assessment and Citizen Action, and Coates's paper on Technology Assessment--New Demands for Information.

The selection from the Program of Policy Studies Evaluation of a Technology Assessment Performed by Oak Ridge National Laboratory on the Modular Integrated Utility System Technology (MIUS) is included for the purpose of indicating a further development in the institutionalization process. This evaluation of an assessment is indication of the need to establish professional standards for judging the adequacy with which assessments are performed and for analyzing the sufficiency of the definition of task-objectives that are given to or posited by assessment entities.

IV. INTERFACE BETWEEN TECHNOLOGY ASSESSMENT AND THE LAW

The first paper in this section undertakes to provide a basic framework for the consideration of the purposes and techniques of scientific method and adversarial system. Similarities and differences in these two techniques of inquiry are considered. The role of scientific method on the one hand and adversarial system on the other, with reference to their relevance in the performance of assessments, is the primary concern of the paper by Mayo, Scientific Method, Adversarial System, and Technology Assessment.

Jones' paper, "Advocacy and Technology Assessment," presents a highly structured and unusually rigorous treatment of adversarial system ass applied to technology assessment. The role of adversarial system in technology assessments, particularly in connection with the discussion of criteria of adequacy of assessments, should be a continuing reference source for those involved in the assessment function.

The monograph by Green on Law's Interface with Expanding Technology presents the author's views on the interaction of technology assessments with the process of political decisionmaking. Green suggests a number of reasons why those engaged in the assessment function should not be overly optimistic of the impacts of assessment outcomes on political decisionmaking.

V. CASE STUDIES

Students of technology assessment have recognized that the purpose or task-objective of assessments may vary greatly, depending either upon the analyst's interest (if he has the privilege of selecting the topic) or upon the requirements of the sponsoring agency if the assessment is undertaken through contractual or grant arrangements.

Many papers and studies which do not conform to a strict notion of an assessment methodology may, nevertheless, indicate phases of thought development about the assessment task or assist in the understanding of the basic purpose of the assessment function, i.e., to clarify policy options or alternative project configurations.

One of the earliest assessments undertaken by the Program was directed to Early Experiences with the Hazards of Medical Use of X-Rays: 1896-1906 by Marx. This is an interesting early attempt

to "feel our way" in assessment methodology as well as to look at the perceptions which existed at the time of the introduction of a significant new technology. The extract selected concerns operation of the technology assessment process in early experiences with the hazards of medical use of X-Rays.

The paper by Wollan, Controlling the Potential Hazards of Government-Sponsored Technology is an early attempt to examine the ability of governmental agencies to adequately assess technological programs or projects to which they are committed. Wollan reviews the hazards of government-sponsored activities, including weather modification, supersonic transport noise, and the value conflicts involved in the flouridation controversy.

The paper by Mayo, Consideration of Environmental Noise Effects in Transportation Planning by Governmental Entities reviews the evaluation of environmental concerns with respect to major transportation systems: the inter-state highway system and commercial air transportation. The paper sets forth in relatively brief form the type of planning that was done for interstate highway system and suggests the shift in social value emphasis that has become apparent during the approximately 20 years since the interstate system was authorized. While the focus of the paper is primarily on transportation noise, it reflects the growing significance of a variety of new concerns about the quality of the social environment in the 1960's and early 1970's.

A paper of considerable current interest is that of Genetic Technology: Promises and Problems by Frankel which is directed to the evaluation of the emerging technologies of genetic medicine.

The paper focuses upon the growing acquisition of new diagnostic capabilities, their consequent impact on screening and counseling for genetic disease, and the policy issues stemming from these capabilities.

The growing concern with energy is reflected in the assessment by Coates in a report on Community Level Impacts of Expanded Underground Coal Mining. This paper perhaps is more representative than any of the others in Part V of the concepts and analytical techniques now associated with technology assessment. The paper identifies and evaluates the potential secondary consequences of rapid community growth in deep mining localities and the ability of affected communities to absorb and manage such growth.

The Abstract from a report An Integrated Strategy for Aircraft/Airport Noise Abatement: A Legal-Institutional Analysis of §7 of the Noise Control Act of 1972 and Proposals Based Thereon is included for the reason that it represents an assessment task-objective which is not always differentiated from the more common approach of proposing a technological project configuration and asking what likely social benefits and costs will result. Rather than being presented with a specific aircraft/airport noise plan for assessment, it was the task of the Program staff to construct and assess alternative abatement configurations. This abstract of a rather substantial report on aircraft/airport noise examines the development of the aircraft noise control structure since the Griggs case of 1962 which crystallized legal doctrine by placing the responsibility upon the airport operator rather than the carriers or the Federal Government, i.e., the public. This legal "one-factor fix" simply was not an ade-

quate solution to a growing social problem. However, ten years elapsed before the Noise Control Act of 1972 undertook to establish the legal-institutional framework within which an adequate aircraft/airport noise abatement program might be initiated with concern for full recognition of all the beneficial and detrimental consequences of air transportation and appropriate distribution of benefits and costs.

II. DEVELOPMENT OF THE CONCEPT OF TECHNOLOGY ASSESSMENT

A. Historical Aspects of Technology-Assessment

Melvin KRANZBERG

August 1969, pp. 1-21

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HISTORICAL ASPECTS OF TECHNOLOGY ASSESSMENT

Technology assessment as a limited art is nothing new. Simple assessment is close to the purpose of any innovation, even if only a mere guess that it will work to some good. It goes back to prehistory. We can imagine some forebear of homo sapiens picking up a stone to kill small game or to beat a neighbor--or his wife--over the head. He had glimpsed the purpose in advance. He immediately confirmed the efficacy of the weapon, no doubt with grunts of delight.

Every new tool, machine, process, technique, design, or product is judged in the light of its efficiency in meeting some need. Technology assessment still tries to answer questions about efficiency, cost, and function related to purpose. These questions run to how to make work easier or life more pleasant, how to make money, how to kill or destroy more effectively, and in general how to achieve specific goals the innovators seek. For most of history, technology assessment has been narrow and immediate, but within these limits perhaps effective. More remote and broader effects were ignored.

The pyramids, for all we know even today, preserved and sustained the pharaohs' ka's, or spirits, in the afterlife. From the standpoint of the pharaohs--and they were the only people whose assessments counted then--the pyramids were a worthy allocation of resources, admirably fulfilling the special requirements for the afterlife of the god-kings. From the standpoint of the millions of workers whose labor built these great monuments and of the inhabitants of Egypt as a whole, the pyramids were an unmitigated disaster. Still, the pyramids satisfied first-order

assessment in the light of Egyptian learning and social structure, which placed the pharaoh at the top of the pyramid, figuratively speading.

Throughout history most other first-order requirements have been economic or military in nature, conceived in the narrowest possible fashion. But second-order effects--effects on the entire economy, social effects beyond the economic, the socio-economic aftermaths of war affecting both victor and vanquished--these were rarely, if ever, considered. Second-order and more remote effects occurred, of course, but their prediction was diffuse and unlikely to be convincing. In that connection I recall a cartoon which appeared many years ago in the late Collier's magazine. A caveman emerging from his cave with a bow-and-arrow remarked to his companion, "This new little invention of mine will make war so horrible that men will never make war anymore."

Only when random invention began giving way to systematic innovation could technology assessment look much beyond first-order effects. Yet failure to assess the far-reaching effects of technology did not, as I have noted, keep them from occurring. Vast improvements in man's living conditions, his conquest of the environment, and the uplifting of social and educational standards were wrought by technological advances in agriculture, construction, transport, and communications--even though for the most part innovations in those fields were made by men who considered only limited first-order effects.

By now we have awakened to the fact that technology has social and human effects which we historians can clearly detect by our 20-20 hindsight. Today we claim--or some of us claim--that these effects are calculable in advance. The historical developments which have brought

about this change I shall discuss under the headings of (1) the broadening through the centuries of the social context for technological change and assessment, (2) the growing need since the Industrial Revolution for assessment, (3) the recent deepening awareness of the impacts of technology, (4) the development of social and communal responsibility for technology, and (5) the current growth in the assessment capability.

Broadening of the Social Context for Technological Change and Assessment

The example of the pyramids showed how technology assessment once was concerned with but a single individual, the god-king. In classical antiquity, and indeed through much of history, the range of assessment extended only to the benefits for a small, elite group. This limited the impetus for technical innovation. The Hellenistic scientists, for example, knew about the power of falling water, the force of air pressure, and the energy of expanding steam. They were familiar with the principles of force pumps, water wheels, windmills, rotary grinders, and even the reaction steam turbine. But instead of using this knowledge and these mechanical appliances to perform work, they made toys.

Hero of Alexandria, who lived in the first century A.D., described 78 machines in his treatise of Pneumatics. There were siphons for producing the illusion of turning water into wine. One contrivance lit fires in hollow altars; the expansion of the air exerted pressure through concealed pipes forcing libations of liquids onto the flame. Another air-expansion device within the altar opened the doors of the temple and later, as the fire died, closed them automatically. Hero is even said to have devised the first automatic vending machine. It sold holy water, an automatic vending market which has so far eluded the Mafia in our country.

Hero and the other Hellenistic scientists failed to apply scientific knowledge and discoveries to control the environment by reason of social, not intellectual, deficiencies. They considered only the welfare of a small number of individuals rather than the entire population. The majority of the people were workers, the lowest elements of society and, in most cases, slaves. There was little need to improve technical devices to save cheap slave labor.

Medieval society, still elitist in nature and contemptuous of manual labor, dropped the institution of slavery, and despite the popular myth to the contrary, the rising classes of artisans and merchants were receptive to technological change. The guilds of canny craftsmen were quite aware that if they failed to adopt an innovation in production, other artisans would, and markets in the next city might be lost.

When the spinning wheel first appeared in Europe toward the end of the 13th century, it must have caused unemployment. Yet the first mention of the spinning wheel in a guild regulation of about 1280 merely prohibited the use of wheel-spun thread in the warp (as distinct from the weft), presumably because it was not yet as strong as that produced by hand. The object, then, seems to have been to protect the quality of the cloth, not to rule out technical improvements.

On close inspection, we find very little guild opposition to industrial changes before the 16th century. When opposition appeared, it was because the pace of technological change was quickening, and a new industrial system was beginning to appear. The guild structure itself was slipping, fighting in vain for its very existence. As a flourishing part of medieval society, the guilds were strong enough to accept

technological change; only when the structure lost touch with the new economic order did the attempt to block change begin.

The medieval guild cannot rightly be compared with the modern labor union. Certainly, however, their limited view of technology assessment in the face of new modes of production, once their very being was threatened, seems fairly analogous. Featherbedding practices and building codes represent indirect forms of technology assessment considering only the welfare of the small segment of the population actually engaged in running trains or building houses, not the welfare of those using them, and certainly not the entire community.

Despite the later guild opposition, the onset of industrialization turned out to be irresistible. Yet, if there was anything that could be called technology assessment, it was limited to first-order economic effects, namely, the profit of individual businessmen. Their sponsorship of technological innovation on behalf of their own self-interest was largely unchallenged because of the concomitant development of new concepts of private property based on natural rights and, somewhat later, on the doctrines of laissez-faire.

When opposition to industrialization began to appear at the beginning of the 19th century, it was confined to small, special-interest groups whose selfish concerns seem almost trivial today. In England some members of the country gentry objected to the spoliation of the countryside. They had in mind their own hunting rights hedged by railroads puffing their way across the landscape. They also resented the rise to economic, and eventually to political, power of the self-made men representing the burgeoning industries.

The Luddite protest, more dramatic, has been interpreted by many as the first indication of worker opposition to the onset of industrialization. We know now that the Luddites destroyed their machines, not so much because they opposed the mechanization of their work, but as a means of venting their anger and frustration at the practices of their employers. Yet the Luddites have become symbolic of opposition to machines. Certainly their protest was a harbinger of things to come insofar as technology assessment is concerned. For the first time, there was a real challenge to the notion that only the profits of the factory owner were to be considered in adjudging the worth of technological change.

Although the factory legislation of the early 19th century was largely ineffectual and did little to stop the gross exploitation of workers, it marked an extension of the concept of technology assessment to include the workers, their health, and their economic welfare. This legislation also brought a new factor into technology assessment--the government. Prevailing laissez-faire doctrines aside, the government intervened to mitigate some of the worst social consequences of unfettered industrialization. It was a sign of things to come.

The man chiefly responsible for broadening the social context of technology assessment was Karl Marx. He made plain one great truth: Technology has social and cultural ramifications far beyond the first-order effects to which attention had hitherto been directed. This view took the central position in the all-embracing Marxian theory of history--a theory which, however unfortunate in politics, has deeply influenced the study of society.

What is more, Marx avoided the confusion between technology itself

and the social system which it had so profoundly affected. Marx's strictures were not against technological change. He called for greater progress in technology and sought to stimulate technical advance. Indeed, he devoted many pages of praise to the industrial bourgeoisie in a work dedicated to its overthrow, called Das Kapital. His effort concentrated not on mitigating the effects of technology but on rearranging, by revolution, a socio-economic system which would enable the benefits of technology to be spread among the masses rather than confined to the profit of a few.

Aside from a few English gentry and some spokesmen for the Romantic movement during the mid-19th century, not many worried about the inroads of industrialization on the natural landscape. In America the concern about the physical environment was largely based not on aesthetic considerations, but on the question of rational exploitation of natural resources. John Wesley Powell, who became director of the U.S. Geological Survey in the last quarter of the 19th century, conducted an irrigation survey to identify, locate, and conserve the fast-disappearing water resources of the arid western lands. Powell's attempts at scientific conservation were at best only partially successful. John Muir,who sought to preserve forest lands from sale to commercial interests,also met with only partial success. Yet environmental considerations were introduced to technology assessment, a factor which was to become of great importance only by the mid-20th century. It was an extension that would bring technology assessment in time to consider the protection of posterity itself, just as the societal context of technological change had already become broadened to include all segments of society.

The Growing Need for Technology Assessment

The Industrial Revolution was a tremendous enlargement in the scale of technology. Not surprisingly, the new dimensions produced enlarged impacts of society and humanity. For one thing, there were simply more people around. For another, all the extra people were more intimately affected by technology due mainly to crowding and the increasing economic interdependence of mankind. Through most human history, the vast majority of mankind had lived in rural areas, and their major occupation had been concerned with agriculture. The Industrial Revolution changed all that. Production, once centered in the hearth and home, now was carried on in factories located in cities. The self-sufficiency of farming life gave way to the close-linked interdependence of individuals in the modern metropolis. Now other groups in society besides the elite, the artisans, the merchants, and the capitalists clamored for some of the benefits of advancing technology. The factory workers' first-order assessment of their own benefit frequently clashed with those of their employers. And beyond them all was society as a whole, whose interests might suffer even if workers and employers could compromise on their mutual benefit.

The need for technology assessment was also heightened by the acceleration of social change, which was itself a corollary of speedier technological change. Anthropologists tell us that among the most deep-seated of cultural habits are courtship patterns. After remaining static for centuries, courtship patterns have been revolutionized several times within our own century. Henry Ford's automobile not only brought the farmer to the city; it also changed the wooing spot from the front parlor to the rumble seat. Just where the locale d'amour is now, I am much too

professorially dignified to find out, though I occasionally stumble over people billing and cooing their way to the bachelor's degree in the bushes of an urban campus. Despite this throwback to the primitive setting, I am always sure--without necessarily looking--that the festivities are being conducted with due regard for second-order assessment of the biological technologies. My own thoughts about the abundant resources of human love, however, are turning increasingly toward conservation.

The United States, too, is rapidly advancing into middle age. Natural resources, like love, once seemed so abundant that little thought had to be given to conservation. As we grew up, advances of scientific technology in new materials and substitutes tended to avoid questions of exhaustion, but we cannot continue to ignore them. Conservation has now become at least a requirement of second-order technological assessment. As one writer has put it, "We have not run out of fresh water in this country; we have simply run out of streams to pollute."

Not only the scale but the cumulative nature of our technical applications is endangering us. The emissions of a few thousand automobiles posed no great threat to the salubrity of the air. Millions of automobiles do pose a serious threat. And DDT provides another example.

Thirty years ago, DDT was hailed as a miraculous insect killer. During World War II, it kept our soldiery free of the lice and vermin infestations which had produced more casualties in World War I than actual combat. In large-scale public health programs throughout the world following World War II, DDT succeeded in wiping out one of mankind's greatest scourges, the malarial-carrying insects. Similarly, when sprayed on crops, it enormously increased agricultural productivity. It

is not surprising that the developer of DDT was awarded the Nobel Prize for Medicine. Yet today DDT is regarded as a potential threat to mankind. Through a process of biological magnification in the food chain, slight traces of DDT build up as poisonous doses in fish and birds, and eventually in man himself. In this way a one-time boon to man has become at best a mixed blessing. The magnitude, accumulation, and human impact of technological change, together with technologically produced social change, have made pressing the need for technological assessment in all human, environmental, and social aspects.

The Deepening Perception of the Impact of Technology

The awareness that technology can sometimes have harmful effects is not new. In classical antiquity, Xenophon expressed a prevailing social attitude when he said in Book IV of the *Oeconomicus*, "What are called the mechanical arts carry a social stigma and are rightly dishonored in our cities. For these arts damage the bodies of those who work at them or who act as overseers by compelling them to a sedentary life and to an indoor life, and in some cases to spend the whole day by the fire. This physical degeneration results also in deterioration of the soul."

Similarly, John Ruskin in the 19th century looked back to an older, medieval England, "ye merrie olde Englande" of cakes and ale and morris-dancing on the green. Unfortunately, ye merrie olde Englande was not "merrie" for the vast majority of its inhabitants who lived in fear, poverty, superstition, and filth. Jacques Barzun of Columbia University is a contemporary example of the aristocratic, nostalgic, romantic discovery of the horrors of technology. His book, *Science: The Glorious Entertainment*, is a compendium of common complaints about modern living: useless

machinery, ugly architecture, tasteless bread, planned obsolescence, offensive advertising, zip codes, automatic telephone dialing, and the like. The destruction of rural life, the mass exploitation of the poor, cancerous growth of cities, and the uglification of the world through noise, fear, and filth--these Barzun and his fellow "bleeding-heart humanists" laid at the door of technology and science.

What strikes me about these criticisms is not that they are based on a perceptive assessment of the social implications of technology but rather upon a false view of an idyllic past. In these days of urban sprawl and the ravenous bulldozer, it is not surprising that many men look back with fondness to small-town life and nostalgically believe that in many ways the past, which they usually identify as anytime before 1914, was much superior to the present. I am not at all certain that American small-town life was really idyllic, and I invoke Sherwood Anderson, Theodore Dreiser, Sinclair Lewis, John O'Hara, the Lynds, and Tennessee Williams as my witnesses. If the small-town "good old days" were really so good, how are we to account for the fact that so many Americans fled the small town? Perhaps the pronvincial, parochial, censorial, gossipy, uncultivated world of Peyton Place does not correspond so much to human desires as the challenge and excitement of the big city with all its traffic snarls, television serials, and perpetual crises. The fact is that the migratory trend is from the countryside to the city, not the other way. A decade from now more than 90% of all Americans, it is estimated, will be living in urban areas.

Not all the broad-scale attacks upon contemporary technological society arise from romantic longings for a non-existent past. The modern

novel, the contemporary drama, and today's poetry have as an insistent theme that man has become the victim of a dehumanizing technology. This literature of anti-technology employs the metaphors of Frankenstein's monster, robots from R.U.R., and the regimented citizens of Brave New World and 1984. The "bleeding-heart humanists" who misquote these works seem confident that their technological target material cannot read the books. What the original books and plays said is not that technology is at fault, but its human abuse. What's worse is the view of man put forth by the non-critics of these works; they claim that man is by nature so abusive, so evil an animal that he cannot be trusted with technology. Well, that is some kind of assessment.

More serious critics base their assessments on better philosophical and literary grounds. Though willing to admit that technology has "raised the ceiling of human achievement," Lewis Mumford claims that modern technology--he calls it "technics"--has become authoritarian and is "transferring the attributes of life to the machine and the mechanical collective." Jacques Ellul has a similar apocalyptic view, feeling that technology has become the end of human life. Fusing ideas borrowed from both Freud and Marx, Herbert Marcuse attacks industrial civilization on the grounds that it has made man "one-dimensional." Even admitting that more men may be happier today than ever before, their happiness, he claims, is "a state of anaesthesia." Though technology has done away with scarcities, it forces men, says Marcuse, to "exhausting, stupefying, inhuman slavery," alienating the workers from each other, from their products, and from work itself. Mass society provides bread, circuses, and technology. Material plenty yields no spiritual gratification and

leads to social oppression. Marcuse holds these principles to be self-evident in both capitalist and communist societies. They characterize industrial civilization no matter what the sociopolitical arrangements may be.

Marcuse offers little in the way of solutions. All efforts at reform are impotent, he claims. Free speech and electoral activity are superficial devices for adjusting people to the status quo. Revolution is all but impossible. Marcuse can only offer strident opposition to the society either by withdrawal or by confrontation which will shock society into changing. Here is technology assessment of the most sweeping character.

While such wholesale indictments may stimulate nihilistic revolutionary movements, they really tell us very little about what can be done to guide and direct technological innovation along socially beneficial lines. Twentieth-century man will never willingly divorce himself from technology nor even consent to a moratorium on further advances. The sentiments uttered by Marcuse and his youthful adherents might ultimately succeed in bringing about major transformations in the softer supporting systems--legal, educational, governmental, economic, and the like. They are ineffectual as to technology because of their intellectual murkiness about changes in the dynamics of technology itself. Still, they render two cheers, heavily, for some kind of technology assessment. Mumford, Ellul, and Marcuse deserve "A" for choice of topic, and "D" for effort. They have nevertheless raised a right question: Do technological innovations really help all mankind or are they only for the benefit of a few? The people who really made the public understand this question were, of course, neither philosophers nor historians.

Rachel Carson, in her book, Silent Spring, first attracted wide attention to the harmful effect of pesticides that persist and accumulate in the environment. Her picture of a silent spring where the birds no longer sing in a despoiled natural environment made her book into a bestseller. It instigated Congressional investigations and scientific studies, and awakened the public. Ralph Nader's book, Unsafe at Any Speed, attracted attention to the problems of automobile safety by showing how Detroit, in its efforts to attract sales through high styling and attempts to economize for competitive reasons, frequently gave second place to safety considerations. His work, too, brought about Congressional investigations and awakened the public to dangers inherent in a technology where motivations for private profit ignored public welfare.

Both books resulted in legislative action, indirectly and directly. Federal legislation for the installation of safety devices in automobiles and an increasing amount of state legislation on DDT bear witness to the effectiveness of these popular writers, the one a first-class scientist, the other a well-educated lawyer, in bringing about meaningful technology assessment. Thanks to Carson and Nader more perhaps than anybody else, awareness of the need for technology assessment has been deepened in the United States.

Development of Social and Communal Responsibility

About a century ago society began to recognize that rampant individualism armed with natural rights doctrine concerned with interests in property did not necessarily result in the social welfare of all. The reason that Adam Smith's "invisible hand" was unseen was because it simply wasn't there. The sum of individual self-interests did not result

in the wealth of nations. If society were to insure security and justice for all its members, it was evident that the government must become a very visible hand in guiding, controlling, and limiting individual rights in the interests of the community at large. This was particularly the case when, through the enlargement of the franchise and the growing democratization of society in both Europe and America during the 19th century, larger numbers of the population could make their voices heard in government and could demand public attention to their needs. Viewed in this light, technology assessment is simply another step in governmental intervention for the common good. Let us look back at some precedents of government direction of technology in America.

In 1824, casualties from boiler explosions on steamboats, particularly an explosion on the Aetna in New York Harbor, which killed 13 and caused many injuries, made Congress take notice. A resolution was introduced in the House of Representatives in May 1824 calling for an inquiry into the expediency of enacting legislation barring the issuance of a certificate of navigation to any boat operating at high steam pressures. This bill did not pass, but the continuance of such explosions during the next few years created a powerful public demand that something be done.

Since nobody knew the exact reason for the boiler explosions, the first order of business was to investigate the cause. In 1830, finally, the government made its first research grant of a technological nature, employing the Franklin Institute of Philadelphia to investigate the cause of boiler explosions. Not until 1836 did the Institute present its full report and make detailed recommendations for regulatory legislation. It was to take another two years before a law was passed, and that so watered

down that the suggested inspection criteria and standards for steamboat engineers were eliminated. Boiler explosions thereupon continued with increasing losses of life. In 1852, at last, a law with teeth in it was passed, with a regulatory agency to enforce it.

Other problems involving technology were taken up in the same piecemeal fashion: first canal building, then railroad building, and, when manned flight was young, the National Advisory Committee for Aeronautics was established. These were followed by the Atomic Energy Commission, the Office of Desalination in the Department of the Interior, and investigating committees on automobile safety, insecticides, and the like. All these agencies were involved in technological goals and purposes, but they confined themselves for the most part to specific problems. Broader assessment has come very slowly.

An attempt to institutionalize and regularize the giving of scientific advice to the government, the prelude to technology assessment, occurred quite early. The National Academy of Sciences was established in 1863, and on the infrequent occasions when it was asked for advice, the advisory approach was used primarily for individual projects or problems. But what about the problems arising from the combined impact of many different systems? And what about social systems in relation to science and technology

Powell's attempt to achieve a rational scientific basis for a conservation program in the western lands was, indeed, a broad-scale approach to the combined impact of several different technological systems and many special interests. However, perhaps the most systematic attempt of the government to confront the consequences of scientific and technological developments was to be found during the New Deal in the Temporary National

Economic Committee (TNEC). The TNEC hearings, begun in December 1938 and lasting 18 months, were triggered by the economic recession of 1937, and they resulted in the most thorough investigation of technology and its implications in our history. The committee sat for 775 hours of testimony, listened to 55 witnesses, and published its hearings; its exhibits, reports, and transcripts fill two good-sized shelves. The problem under closest scrunity was of course technological unemployment. Nevertheless, the research potential of industry and the effects of the patent system in encouraging technological advance were considered on issues of corporate monopoly, which was at the whipping post. Representatives of special interest groups-largely labor and management-made their cases. Few witnesses represented the public interest. Little consideration was given to second-order effects of technological advance, although much was implicit in the economic analyses presented to the committee. The President's Commission on Technology, Automation, and Economic Progress in the 1960's made a similar large-scale effort to consider the effect of technological change on American society. Yet it, like the TNEC, was a "one-shot deal;" it did not represent a continuing effort in technology assessment.

Parallel with these short-lived efforts to view the larger social consequences of technological change was an extension in the concept of the public whose welfare the government sought to serve. Pesticides again provide the example. The first federal law dealing specifically with pesticides was the Federal Insecticide and Fungicide Act of 1910, which sought to protect the pesticide user--the farmer--from being bilked by manufacturers who were selling him inferior products. It took almost three decades before the protection of the federal government was extended

to the general consumer, the public which ate the food products grown with the aid of pesticides; this was the 1938 Food, Drug, and Cosmetic Act which was designed to protect the consumer from harmful chemical residues in his food. Rachel Carson gave a new dimension to the concept of the consumer of pesticides by showing their effects on wildlife.

As of now, therefore, several federal agencies are concerned with protecting the public in regard to pesticides: the Department of Agriculture protects the farming public which uses pesticides in growing crops; HEW protects the consuming public which eats food products grown with pesticides; and the Department of Interior is concerned with protection of wildlife and, in a sense, with the protection of future generations of Americans, by attempting to preserve the ecological balance for posterity. The pesticide story thus manifests the development of governmental responsibility for the social impact of technology; it reflects a broadening of our national goals from a preoccupation with narrow economic elements to the physical health of the consumer and, ultimately, the general social welfare of the people and their physical environment. Or, looking at it in another way, we find that our government of the United States must concern itself with the welfare of all the inhabitants of our land--birds, bees, animals, and fishes, as well as that peculiar animal, man.

Increasing Assessment Capabilities

Given the historical opportunity, need, concern, and precedents, have we developed the know-how for meaningful technology assessment? I need not review in any detail the very recent history of man's growing ability to collect and manipulate data. Both the hardware and the software

are becoming increasingly accurate and sophisticated, enabling us to deal with dynamic variables in complex situations. Along with these are fundamental developments in mathematics, statistics, and general systems theory. Attendants at an Engineering Foundation Research Conference scarcely need to be reminded of the great strides made in our ability to store and retrieve information.

Many scientists and engineers tend to be skeptical of these techniques when applied to problems involving human and social factors. Though such skepticism may have been warranted only a decade or so ago, it can no longer be maintained. It is now possible to produce dynamic models of systems involving complex human and social variables, and our skill is growing. Systems and operations researchers are increasingly competent to provide probabilistic data regarding the impact of scientific and technological decisions on social trends and changes. Though the information may not be so "hard" as that obtained in the physical sciences, it represents a giant leap forward--to use a now famous phrase--in man's ability to quantify social behavior and to develop social indicators. It is precisely in this area of second-and-higher-order effects that our assessment capabilities have progressed.

Yet our growing knowledge and expertise in the behavioral sciences would be of little value in technology assessment if not accompanied by the growth in our scientific and technological capabilities. These give us technological alternatives which alone can make technological assessment reasonable and meaningful.

Let me explain. In societies where the level of science and technology is low, they must make use of any and every technological advance which

they can afford in order to subsist, even if the applications have harmful side-effects. For example, while Sweden and the United States can afford to ban DDT, countries like India cannot afford to do so. It would not be economically feasible for India to change to an insecticide less persistent than DDT which would require spraying every few weeks instead of twice a year. Yet India must have the insecticidal benefits from DDT despite its harmful effects. Its use there has cut down the incidence of malaria from 100 million cases a year to only 15,000 cases, and the death rate from 750,000 to 1,500 a year. In more advanced industrial countries with higher standards of health, malaria presents no such problems.

Furthermore, our higher technological level enables us to use technological alternatives at a slightly higher cost, let us say. The search goes on for other methods of pest control--chemical, mechanical, and biological--and it is quite likely to be successful. Only nations possessing this kind of potential can offer technological alternatives allowing response to unfavorable technology assessments.

What I am really saying is that one major result of the technological revolution of our time is to increase man's choices and options. Our high level of scientific knowledge and technological performance gives us the ability to pick and choose among different ways of accomplishing our social goals. This possibility of choice makes technology assessment both meaningful and possible.

Conclusion

One of the clichés of our time is the well-known statement that "there is nothing so powerful as an idea whose time has come." This is powerful rhetoric but bad history. Anybody can name several ideas whose

time is long past but which exhibited little power. Notable among these are the concepts of world peace and human brotherhood. They have been around for some 2000 years, accepted in theory but never in practice.

Technology assessment strikes me as an idea whose time has come, but I think it also has the power. It, too, is a matter of the human heart, but it also has some powerful hardware and interests behind it.

In this brief review of the historical aspects of technology assessment, I have endeavored to outline the development of the factors suggesting that the time has come for technology assessment. Technological changes now have a broader and accelerating social impact. The need exists; the awareness of the need exists; precedents for its application are manifold; and we are developing the capabilities to apply it effectively.

What really counts--and the examples of world peace and human brotherhood plague us on the point--is our willingness to apply it in practice.

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II. DEVELOPMENT OF THE CONCEPT OF TECHNOLOGY ASSESSMENT

B. Technology and Public Policy: The Process of Technology Assessment in the Federal Government

Vary T. COATES

July 1972, pp. 1-36 (Summary)

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CHAPTER 1

THE CONTROL AND DIRECTION OF ADVANCED TECHNOLOGY

Introduction

The accelerating rate of technological change and development in the twentieth century has raised serious questions concerning the ability of democratic systems to control and direct technological development in ways compatible with both the protection of present and future public interest and the survival of individual freedom. In highly industrialized societies scientific invention, technological innovations, and public policy alternatives are inextricably intermeshed. Consequently much of political theory in the twentieth century has focused on the problem of democratic decisionmaking. Political philosophers have asked: Will the highly complex decisions which determine the quality of men's lives, the conditions of their labor, and the shape of their physical environment, necessarily be made by an elite class of specialists and technocrats? Will such decisions be made within an anonymous and non-responsible corporate structure? Can we escape this fate only at the cost of a highly controlled, totalitarian State? Or will the technocratic elite, the corporate structure, and the governing process inexorably merge, while the mass of men, unable to participate meaningfully in decisionmaking, lapse into apathy or alienation?

Professor Stafford Beer, Professor of Cybernetics at Great Britains' Manchester University, testifying before a congressional committee in 1970, said:

> "...(Technology now seems to be leading humanity by the nose. We appear to have no sense of priorities where our problems are concerned; we do what is technologically easy -- and we do it regardless of cost."[1]

Professor Beer was concerned with the apparent failure of democratic societies to develop systems of management and control which are adequate to the complexities of their internal and external environments. The alternative which he offered was to "design a stable society," recognizing that this will involve "the deployment of a political science to new ends" by treating our "complexity-control capability...as offering a nervous system for the body politic."

The belief that, as Beer phrased it, "technology is leading humanity by the nose," is now widespread. A pessimistic attitude toward technological development is not new (such was an important part of English Conservatism and of the Romantic Movement in the eighteenth century, for example). But such pessimism has become widespread only in the middle of the twentieth century. J. B. Bury, in his seminal work on The Idea of Progress, shows how the burgeoning of technology was the key to

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[1]Stafford Beer, "Managing Modern Complexity," in U.S., Congress, House, Eleventh Meeting of the Panel on Science and Technology with the Committee on Science and Astronautics of the U.S. House of Representatives, The Management of Information and Knowledge, January 27, 28, and 29, 1970, 91st Cong., 2nd Sess., 1970.

the intellectual revolution by which human history was reformulated as the march of Progress:

> "The spectacular results of the advance of science and mechanical technique brought home to the mind of the average man the conception of an indefinite increase of man's power over nature as his brain penetrated her secrets. The evident material progress which has continued incessantly ever since has been a mainstay of the general belief in progress which is prevalent today."[2]

It was not until modern technology had permeated the lives of common men and instigated sweeping social changes that history could be viewed as an open-ended process of change through which improvement of the quality of life for the masses was a possible if not an inevitable condition:

> "It was not until commerce, invention, and natural science emancipated humanity from thralldom to the cycle and to the Christian epic that it became possible to think of an immense future for mortal mankind, of the conquest of the material world in human interest, of providing the conditions for a good life on this planet without reference to any possible hereafter... (O)f all the ideas pertinent to the concept of progress, to the interpretation of what has gone on during the past two hundred years and is going on in the world, none is more relevant than technology."[3]

But the same transformation of ordinary life by technology which helped to produce and gain acceptance for the idea of progress, eventually brought pessimism about further technological development. Melvin Kranzberg, an historian of science and technology, has identified broad historical trends which prepared

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[2] J. B. Bury, The Idea of Progress (New York: The Macmillan Company, 1932; republished by Dover Press, 1955), p. 324.

[3] Charles A. Beard, in an Introduction to Bury's work cited above, pp. xi and xxi.

the way for a more critical attitude toward technology.[4] He traces the steady broadening of the social context of science and technological change from the early stages when science was monopolized by the priesthood of Egypt and used to preserve its own power, and the era of classical Greece, when Science was viewed as a field of intellectual inquiry with little incentive to develop practical applications. Enlargement of the scale of technological application occurred explosively during the industrial revolution and has accelerated throughout the twentieth century. Accumulation of detrimental impacts, such as pollution, from the overwhelmingly large-scale utilization of technologies became only in recent decades so obvious as to generate wide public awareness of such consequences. In the last thirty years there has also been an increasing assumption of societal responsibility for technology as public institutions became subsidizers of technological innovation.

Throughout most of history the impetus for technological innovation was the expectation of direct benefits for the user and for relatively small segments of society, usually the economically dominant class (as Marx said, the owners of the dominant mode of production). Social costs, in terms of loss of common lands, spoilage of local environments, or adverse conditions of labor were transferred to classes which were excluded from

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[4] Melvin Kranzberg, <u>Historical Aspects of Technology Assessment</u>, The George Washington University Program of Policy Studies in Science and Technology, Occasional Paper No. 4 (Washington, D.C.: The George Washington University, August 1969).

political power (whether Egyptian slaves, medieval serfs, or cottage factory workers); such costs need not be considered and could almost be said to have been invisible. The plentiful supply of natural resources and manual labor and -- after the rise of liberalism in the eighteenth century -- the concept of limited government, allowed technology to develop relatively free of consideration of larger social consequences.

After the onset of the industrial revolution, bringing with it increases in population, concentration of people into work centers, and increasing economic interdependence, the acceleration of social change attendant on technological development could no longer be ignored. Adam Smith, Thomas Malthus, and Karl Marx provide the landmarks in recognition of the effects of technology on society. Kranzberg notes of Marx:

> "He made plain one great truth: Technology has social and cultural ramifications far beyond the first-order effects to which attention had hitherto been directed... What is more, Marx avoided the confusion between technology itself and the social system which it had so profoundly affected. Marx's strictures were not against technological change...His effort concentrated not on mitigating the effects of technology but on rearranging, by revolution, a socio-economic system which would enable the benefits of technology to be spread among the masses rather than confined to the profit of the few."[5]

In the last two decades the social costs, rather than the benefits, of technological development have increasingly been the center of attention in the United States. The possibility of world-wide overpopulation, the threat of exhaustion of natural

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[5] Ibid., p. 7.

resources, the cumulative effects of overwhelmingly large applications of technology on the environment, and chemical hazards to human safety and health have generated acute concern. The decisions which produced these effects were largely marketplace decisions, in spite of the steady increase in governmental intervention in the economy since the 1900's. Indeed, federal, state, and local governments are among the heaviest users of technology and have become increasingly the subsidizers and promoters of technological innovation.

During the New Deal era in the United States and while totalitarian governments in Europe, Asia, and South America occupied the center of political consciousness, political theorists directed most of their attention to the threat of all-powerful governments. More recently political thinkers are again pointing to the seeming inability of democratic societies to provide what Stafford Beer called "stable metasystems," for the control of self-directed, change-resisting social institutions which are powerfully organized to maintain their internal stability and survival. In the industrial society such social institutions -- industries and the specialized interest groups and professions associated with them -- will through the dynamics of insuring their institutional survival make decisions which a limited government (designed for a less complex society of the past) may lack the power or the initiative to make in the public interest. Beer warned a somewhat puzzled congressional committee:

> "The central thesis of cybernetics might be expressed thus: that there are natural laws governing the behavior of large interactive systems -- in the flesh, in the metal, in the social and economic fabric. These laws have to do with self-regulation and self-organization...(T)his behavior is governed by the dynamic structure of the system...Outcomes are latent in the dynamic structure of the systems we have or may adopt: they will inexorably emerge."[6]

Victor Ferkiss, in Technological Man: The Myth and the Reality, also pointed out that the most serious danger to democratic decisionmaking today is not hypercontrol but chaos:

> "The danger is not that industrialism has destroyed the intermediate group in modern democratic society but that the group is so strong that the individual, instead of finding freedom in the interstices created by group competition, may be crushed between the contending parties, or that instead of a dominant total government riding roughshod over an inert society, public purposes will be lost sight of in the feudalistic struggle of competing special interests."[7]

Ferkiss, like Stafford Beer, sees this problem in cybernetic terms as a failure of control and communication under an overload of conflicting demands on the body politic due to the complexity of technological society:

> "...(T)he lines of power and control are more and more intermeshed...The total social organism has a central nervous system, but so overwhelming are the desires and signals from its constituent parts, so involuntary most of its actions...that it is impossible to speak of it as being directed consistently by a single conscious will...The sheer volume of activity leads to communications problems that make centralized direction difficult. Indeed, here as elsewhere in technological civilization, the paradox is that not uniformity but anarchy may present the greatest danger..."[8]

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[6] Beer, op. cit.

[7] Victor Ferkiss, Technological Man: The Myth and the Reality (New York: George Braziller, 1969), p. 155.

[8] Ibid., pp. 177-178.

John Kenneth Galbraith, warning that social goals are being subordinated to the ends of technological growth and economic expansion, argues for greater use of governmental power.[9] Henry S. Kariel makes a similar argument that limited government in the classical liberal sense is no longer adequate:

> "When industry is allowed to follow its own logic, when technological expansion and economic growth become exclusive objectives to which others are sacrificed, and when politics is kept from interfering with the inner imperatives and self-evident 'success' of industrial development, men are apt to find themselves deprived of effective freedom even while they are provided with its indispensable material conditions.[10]

"Post-industrial" society, Daniel Bell has noted, is characterized by the pre-eminence of the professional and technical class" and "the centrality of theoretical knowledge as the source of innovation and policy formulation."[11] Other writers have pointed out the danger that ordinary citizens and their elected officials will tend because of the increasing complexity of public policy issues to defer to an elite whose prestige and influence rest on information and expertise. Robert E. Lane foresees "a shrinking of the political domain,"[12] and Jean Meynaud although rejecting the thesis that a "power elite," is

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[9] John Kenneth Galbraith, The New Industrial State (Boston: Houghton Mifflin, 1967).

[10] Henry S. Kariel, The Promise of Politics (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1966).

[11] Daniel Bell, "The Measurement of Knowledge and Technology," in Indicators of Social Change, Eleanor Sheldon and Wilbert E. Moore, eds., (New York: Russell Sage Foundation, 1968), p. 157.

[12] Robert E. Lane, "The Decline of Politics and Ideology in a Knowledgeable Society," American Sociological Review 31 (October 1966), pp. 649ff.

now in control, demonstrated how political power may shift toward technocrats, who have a dangerous tendency to form closed groups and who exhibit a strong bias toward the interests of managers and professionals.[13]

Galbraith, who like Ferkiss and Kariel has called for greater exercise of public power to counter the economic power of industries and the competing demands of specialized interests, has also said that

> "(I)ncreasingly, it will be recognized that the mature corporation, as it develops, becomes part of the administrative complex associated with the State. In time the line between the two will disappear."[14]

The fear that government itself, responding to the necessity of exerting control over increasingly powerful forces of economics and technology, may centralize and consolidate power to an extent that destroys individual freedom, goes back to the traditions of liberal thought since the industrial revolution. Writers like Robert Boguslaw, Robert O. MacBride, Donald N. Michael, and Alan Westin contend that this danger takes on new dimensions with the possibility of national data banks, information systems, and other electronic devices which enormously

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[13] Jean Meynaud, Technocracy (London: Faber and Faber, 1968), pp. 293-303.

[14] Galbraith, op. cit., p. 393.

increase the powers of a State for surveillance of individuals.[15] Professor Emmanual G. Mesthene (himself rather optimistic about the influence of technology on political decisionmaking) formulates the long-standing liberal warning in modern terms:

> "There is...the problem of what happens to traditional relationships between citizens and government, to such prerogatives of the individual as personal privacy, electoral consent, and access to the independent social criticism of the press, and to the ethics of and public controls over a new elite of information keepers, *when economic, military, and social policies become increasingly technical, long-range, machine-processed, information-based, and expert-dominated*." (Italics added)[16]

Recognition that modern governments, whether in opposition to, or in conjunction with, technocratic elitists and corporate interests, may irretrievably erode the sphere of individual choice and freedom, leads many writers to argue (unlike Ferkis, Kariel and Galbraith) against unnecessary use of governmental powers. Herman Kahn and Anthony Wiener urge that:

> "...(W)e try in general to moderate Faustian impulses to overpower the environment, and to try to limit both the centralization and the willingness to use accumulating political, economic, and technological power... so that the inescapable increase in regulation of human choices remains in the hands of people who will

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[15] Robert Boguslaw, *The New Utopians: A Study of System Design and Social Change* (Englewood Cliffs, New Jersey: Prentice-Hall, 1965). Robert O. MacBride, *The Automated State: Computer Systems as a New Force in Society* (Philadelphia: Chilton Book Company, 1967). Donald N. Michael, "On Coping with Complexity: Planning and Politics," *Daedalus* 97 (Fall 1968), pp. 1179-1193. Alan F. Westin, *Privacy and Freedom* (New York: Atheneum, 1967). For an excellent discussion of these and other writers on the topic of computer technology and freedom, see *Technology and the Polity*, Harvard University Program on Technology and Society, Research Review No. 4 (Summer, 1969), pp. 31-36.

[16] Emanuel G. Mesthene, *How Technology Will Shape the Future*, Harvard University Program on Technology and Society Reprint No. 5, reprinted from *Science* 161 (12 July 1968), p. 19.

respect its disastrous potential and will not unnecessarily centralize it further."[17]

The issues raised by these and many other thinkers may perhaps be summarized: To what extent is our present form of government capable of generating direction and control over technological development which can enable us both to achieve social goals and protect public interests, and to protect individual participation, privacy, and options within a guaranteed and suitably broad sphere?

Technology Assessment

Beginning about 1966 in the United States the concept of Technology Assessment has been discussed as a technique for improving societal control over technological development and applications within the constitutional framework and institutional structure of the federal government. By technology assessment is meant the systematic identification, analysis, and evaluation of the potential secondary consequences (whether beneficial or detrimental) of technology in terms of its impacts on social, cultural, political, economic, and environmental systems and processes. Technology assessment is intended to provide a neutral, factual input into the decisionmaking process.

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17 Herman Kahn and Anthony J. Wiener, "Faustian Powers and Human Choices: Some Twenty-First Century Technological and Economic Issues," in Environment and Change, the Next Fifty Years, William R. Ewald, Jr., ed., (Bloomington: Indiana University Press, 1968), p. 101.

Assessment techniques may be integrated into the planning, designing, and evaluative process used by government agencies in preparing technology-oriented programs and projects, and may also provide a critical review of such programs and projects after their injection into the public policy arena.

The present study, Technology and Public Policy, is intended to provide a descriptive and analytical review of the concept of technology assessment and the current status of its application in the work of federal executive agencies. The remainder of this chapter will examine the origin of the term technology assessment, a brief history of its discussion and development since 1966, and some of the factors influencing that development. Subsequent chapters will examine the work of federal agencies concerned with technological programs and projects and the extent to which they are utilizing or can be expected to utilize the technique of technology assessment.

It should be noted that many of those who have written about technology assessment suggest that the technique can or should be used in private sector decisionmaking. As used in this study, however, the term technology assessment is limited to studies which are intended to provide input into or to influence public sector decisionmaking.

The word "technology" itself requires some comment. The dictionary definition of "technology" is "applied science; a technical method of achieving a practical purpose; the totality

of the means employed to provide objects necessary for human sustenance and comfort."[18] The McGraw-Hill Encyclopedia of Science and Technology says that technology is "the systematic use of industrial processes, tools, and techniques for the accomplishment of specific planned functions." According to this encyclopedia, science is organized knowledge, engineering is planning and design based on organized knowledge and aimed at modification of the physical environment, and technology is the technique by which such modification is carried through. Some thinkers use a much broader definition of technology which includes institutional or legal innovations. John Wilkerson, the translator of Jacques Ellul's La Technique (translated as The Technological Society) describes technique as "the organized ensemble of all individual techniques which have been used to secure any end whatsoever," and further quotes Lasswell as defining technology as "the ensemble of practices by which one uses available resources to achieve values."[19]

However, technology as used in this paper does not include processes and techniques which are purely behavioral, legal, or institutional (such as psychoanalysis, a guaranteed annual wage, or day-care nurseries). The subject of discussion is the assessment of "hard" technologies involving the use of industrial

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[18] Merriam-Webster Seventh New Collegiate Dictionary, 1965.

[19] Jacques Ellul, The Technological Society, translated from the French by John Wilkinson (New York: Knopf, 1964), p. vi.

processes, tools, and techniques, and generally intended to modify either the physical environment or the human body, although the assessment may deal with the full range of secondary and higher order consequences.

Development of the Concept of Technology Assessment: 1966-1970

On March 7, 1967, Representative Emilio Daddario introduced before the Congress a bill proposing the creation of a "Technology Assessment Board" to assist the Congress in making wise decisions concerning the use of science and technology and to provide Congress with an "early warning signal" of the potential good and bad consequences of technological programs. Representative Daddario stipulated that this bill was intended "not as a piece of perfected legislation but as a stimulant to discussion."[20]

Daddario, who was then Chairman of the Subcommittee on Science, Research, and Development of the House Committee on Science and Astronautics, defined technology assessment as:

> "...a form of policy research which provides a balanced appraisal to the policymaker. Ideally, it is a system to ask the right questions and obtain correct and timely answers. It identifies policy issues, assesses the impact of alternative courses of action, and presents findings. It is a method of analysis that systematically appraises the nature, significance, status, and merit of a technological program...(and) is designed to uncover three types of consequences -- desirable, undesirable, and uncertain... To assess technology one has to establish cause and effect relationships from

[20] U.S. Congress, House, Committee on Science and Astronautics, "Technology Assessment," Statement of Emilio Q. Daddario, Chairman, Subcommittee on Science, Research, and Development of the..., 90th Cong., 1st Sess., 1967.

> the action or project source to the locale of consequences... The function of technology assessment is to identify...both short-term and long range (impacts)."[21]

In the sense in which Mr. Daddario here used it, the term "technology assessment" had apparently been used for the first time in a report of his Subcommittee a few months earlier, October 17, 1966.[22] This report was concerned with undesirable consequences of technology, which the subcommittee noted were appearing with alarming frequency: technological unemployment, toxic pesticides, pollution, automobile effluents, forest depletion, exhaustion of resources, disposal of radioactive wastes, invasions of personal liberty by computerized information systems and electronic surveillance, and the effects of carbon dioxide on climate. The subcommittee said that, in the past,

> "...man could afford to look upon the innovations of technology with some complacency. For the innovations came slowly, they were put to use in a relatively slow and modest fashion, and their side effects developed at a sufficiently relaxed pace to permit man to adjust

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[21] _Ibid._, pp. 12-13.

[22] According to Franklin P. Huddle of the Science Policy Research Division of the Congressional Research Service, Library of Congress, in a paper entitled "Government Technology Assessment: the Role of the Social Sciences," presented at a Round Table Discussion of the American Political Science Association, October 2, 1970. The author is indebted to Dr. Huddle for the use of this paper in preparing the present historical discussion. The term technology assessment is frequently used by engineers and other technologists to mean evaluation of the performance of a system, i.e., assessment of intentional, first order consequences only.

to them -- or to alter his course if the threat were great enough."[23]

Under the leadership of Mr. Daddario the members of the Subcommittee had been inquiring into reports of "ecological disasters" which were appearing in newspapers across the country and in books such as Rachel Carson's Silent Spring.[24] According to researchers at the Congressional Research Service (then the Legislative Reference Service) who assisted the subcommittee in these deliberations, the members had been particularly impressed by a suggestion of Col. Charles Lindbergh, an ardent conservationist, that some method was needed to anticipate such detrimental impacts at an early stage of technological developments. The term technology assessment was chosen, some observers remember, in order to assure that any future legislation dealing with such activity would be referred to the Subcommittee on Science, Research, and Development.

When Mr. Daddario introduced his proposal to establish a Technology Assessment Board, he told the Congress in an accompanying statement,

> "Technical information needed by policymakers is frequently not available, or not in the right form. A policymaker cannot judge the merits or consequences of a technological program within a strictly technical context. He has to consider social, economic, and legal implications of any course of action."

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[23] U.S. Congress, House, Committee on Science and Astronautics, "Inquiries, Legislation, Policy Studies Re Science and Technology: Review and Forecast," Second Progress Report of the Subcommittee on Science, Research, and Development, 89th Congress, 2nd Session, 1966, p. 25.

[24] Rachel Carson, Silent Spring (Boston: Houghton Mifflin, 1962).

The problem for Congress in dealing with technological innovation is therefore one of providing itself with information about scientific and technological possibilities and options, in a form intelligible to and useful for nonspecialists decisionmakers. The Daddario Subcommittee decided to explore the idea of technology assessment further through the holding of seminars and public hearings, and by commissioning several studies of the subject, by the National Academies of Sciences and Engineering and by the Legislative Reference Service.

In the fall of 1967 the Subcommittee invited a number of specialists in policy sciences to a seminar on Technology Assessment. President Bowen of the University of Iowa, the former chairman of the National Commission on Automation, Technology, and Economic Progress, called attention to another aspect of the social direction of technology, the need to establish consensual goals and priorities for the immediate and long-range future of the nation. He therefore proposed both the establishment of a technology assessment "council" to serve the federal government, and the establishment of a "commission on national goals."[25]

The Library of Congress Study. The study which the Subcommittee had requested from the Legislative Reference Service was submitted in the spring of 1969. Technical Information for

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[25] U.S. Congress, House, Committee on Science and Astronautics, "Technology Assessment Seminar," Proceedings before the Subcommittee on Science, Research, and Development, September 21 and 22, 1967, 90th Congress, 1st Session, 1967 (revised August 1968), pp. 5-6.

Congress, by Dr. Frank P. Huddle, examined fourteen cases in which the Congress had acted on issues concerned with technology, such as the Salk Vaccine, the nuclear test ban treaty, the Mohole research program, and water policy formulation.[26]

In each of these cases Dr. Huddle examined conflict between scientific and political decisionmaking, differences between scientific and political information, and differences between scientific and political behavior. He concluded that the technical aspects of political issues should receive priority attention and that "it is important that the scientific question or issue be carefully framed so that the answer to it provides a useful and significant piece of evidence for guidance in the consideration of the broader political issue." When the technical questions are not firmly resolved, Dr. Huddle noted, "the political resolution of the broader issue tended to be defective."[27]

Perhaps the greatest difficulty which Huddle noted in supplying Congress with scientific information was that "the lay members of Congress found it impossible to accept the proposition that science is probabilistic," and were apt to accept "invalid hypotheses" (sic) and to make "improper use of outstanding personalities." Huddle therefore suggested the need for

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[26] U.S. Congress, House, Committee on Science and Astronautics, Technical Information for Congress, Report to the Subcommittee on Science, Research, and Development, prepared by the Science Policy Research Division, Legislative Reference Service, Library of Congress. House Document No. 91-137, 91st Congress, 1st Session, April 25, 1969.

[27] Ibid., p. 506.

information input from a wide range of disciplines, including -- in every assessment involving "the interaction of man and machine" -- the social sciences; and he stressed that technology assessment must be an iterative process:

> "The more time that can be given to this new process, to the progressive sequences of interactions of new fact and analysis, the more mature and sound will be the ultimate decision."[28]

At the same time, delay in decisionmaking can allow irreversible detrimental impacts to occur. Therefore, Huddle concluded, it is important that the process of technology assessment "should begin to occur as far upstream as possible," and he urged that "by institutionalizing and systematizing (the assessment process) the quality and efficiency of the process can be improved."

The National Academy of Sciences Study. A second report on technology assessment was submitted to the Committee on Science and Astronautics by the National Academy of Sciences in July, 1969.[29] This report was prepared by a Panel of the Committee on Science and Public Policy (COSPUP) chaired by Professor Harvey Brooks of Harvard University. The report described the existing process of governmental assessment and decision as "critically deficient" in several regards:

-- Technologies are assessed on the basis of economic benefit to the user rather than on the basis of general social benefits,

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[28] Huddle,"Government Technology Assessment,"p. 15.

[29] Technology: Processes of Assessment and Choice, Report of the National Academy of Sciences to the Committee on Science and Astronautics, U.S. House of Representatives (Washington, D.C.: Government Printing Office, July 1969).

-- "External" costs of technological applications, e.g., pollution, are ignored,

-- In the process of resource allocation, there is a lack of criteria that recognize "the full spectrum of human need,"

-- The burden of proof "has tended to fall on those who challenge the wisdom of an on-going technological trend,"

-- Waiting until deleterious effects become evident "entails too high a risk that vested interests -- among both producers and consumers -- will by then become so entrenched as to make it politically very difficult or economically very costly to suppress or modify an offending technology or to develop an alternative one."[30]

The COSPUP panel outlined conceptual, institutional, and methodological constraints on improvement of the assessment process, but it recommended the establishment of new mechanisms within the federal government whose functions would be the sponsoring and funding of basic research on technical problems and of technology assessments, the continuing review of assessments made by other government institutions, and the dissemination of information about technology assessments. The report suggested that a technology assessment center be located within an expanded Office of Science and Technology in the Executive Office of the President, working in close conjunction with a technology assessment division to be located in the National Science Foundation. A separate assessment component, the Panel said, was needed to serve the Congress and provide it with an independent source of assessment information.

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[30] Ibid., pp. 34-35.

The COSPUP report also included a first attempt at structuring a methodology for technology assessment. Recognizing that there was "no unique way to break down so vast a subject," the panel conceptualized the task in three interrelated subject areas: the focal points from which assessment should begin, assessment modes and mechanisms, and patterns of response and action.

The focal points for assessments, the panel suggested, might be the technology, the environment, or the individual. Technology was here defined as "a system of interrelated innovations, some technical and some social, which comprise some sort of coherent nexus pertaining to systematic manipulation of the environment," e.g., automobile transportation or cable television.

Beginning with this focal point an assessment must consider both economic, social, and legal arrangements which would facilitate introduction and use of a technology, and arrangements which could constrain or regulate its use. The assessment must then examine:

-- the rate of advancement in development of the technology,

-- possibilities for technology transfer to related areas,

-- probable growth in the scale of application,

-- availability of intermediaries or buffers between technology and user (in the case of drugs, the doctor; in the case of construction, building codes),

-- degree of departure from existing, accepted technologies,

-- economic concentration of producers,

-- centralization of decision making with regard to the technology and susceptibility to collective control,

-- the competitive environment,

-- societal sources of resistance to use of the technology (legal, social, religious).

Another focal point for assessment is the environment, and the effects on it of the technology, whether these effects are aesthetic, changes in ecosystems, or biomedical in nature. However, the panel said that: "...pending further attention to definitional and other basic matters, the contemporary interest in environmental issues will make its major contribution to technology assessment by providing impetus for action rather than by furnishing such action with an organizational focus."[31]

Assessments might also use as their focal point, the individual. Here the panel suggested that the assessment should inquire what effects technology, or a specific technological application, are having on:

-- the development and socialization of the child,

-- the work experience of the adult,

-- access to material goods and social values,

-- opportunity to participate in decisionmaking,

-- health and safety.

The COSPUP panel concluded that a combination of all of the three focal points was required in an adequate assessment because of the possibility of synergistic effects and the possibility that either important second- and third-order consequences would be overlooked, or new developments in technology would go unnoticed.

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[31] Ibid., p. 132.

In discussing assessment modes and mechanisms, the panel distinguished between internalized assessments, that is, assessment built into the incentive structure of the decisionmaking process; and externalized assessments, that is, assessment conducted by an institution deliberately separated from the front-line decisionmaker. The panel strongly preferred internalized assessments, on the grounds that they tend to "redefine responsibility without separating it from authority,"[32] although the panel recognized the need for external assessment also in order to make the system function properly: "Ideally, the effort should be to modify goals and criteria of success without dictating the means of achieving them."

The COSPUP panel here failed to explore the problem of institutional bias in agencies assessing their own projects and programs. However, the panel also distinguished between negative assessment, usually performed by agencies with regulatory responsibilities, and positive assessment, by an agency responsible for evaluating and promoting new technology. This terminology was revealing in that it seemed to assume a one-sided approach to assessment calculated to protect the agency's interest, and the conclusion reached by the panel was somewhat counter to its announced preference for internalized assessment: "The solution the panel has urged is a second-order assessment activity performed by an agency with neither promotional tasks nor risk-preventing responsibilities, an entity ancillary to the activities of all agencies with one or the other kind of bias."[33]

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[32] Ibid., p. 139.

[33] Ibid., p. 140.

Finally, the COSPUP panel considered possible patterns of response to technology assessments -- changes or modifications in introduction, support, or use of technology through: resource allocation decisions, modifying private initiatives by internalization of costs or enforcement of standards or regulations, or the altering of incentives through creation of new legal rights or other social innovations. The panel suggested that assessments should be structured so as to be appropriate for the ends in view and the needs of specific decisionmaking entities.

"If society persists in its present course," the COSPUP panel warned, "the future holds great peril, whether from the uncontrolled effects of technology itself or from an unreasoned political reaction against all technological innovation."[34]

The National Academy of Engineering Study. A third report was also submitted to the Daddario Subcommittee in the summer of 1969 by the National Academy of Engineering. A Study of Technology Assessment was prepared by the Committee on Public Engineering Policy (COPEP) chaired by Chauncey Starr, Dean of the School of the University of California at Los Angeles.[35] This study went somewhat beyond the National Academy of Sciences effort in that COPEP performed three "experiments in technology

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[34] Ibid., p. 118.

[35] A Study of Technology Assessment, Report of the Committee on Public Engineering Policy, National Academy of Engineering, to the Committee on Science and Astronautics, U.S. House of Representatives (Washington, D.C.: Government Printing Office, July 1969).

assessment," preliminary examinations of the technology assessment task in the fields of Teaching Aids (instructional television and computer-assisted instruction), Subsonic Aircraft Noise, and Multiphasic Health Screening.

In conducting these experimental assessments, COPEP used a seven-step analytical approach, as follows:

1. Identify and refine the subject to be assessed.
2. Deliniate the scope of the assessment and develop a data base.
3. Identify alternative strategies to solve the selected problems with the technology under assessment.
4. Identify parties affected by the selected problems and the technology.
5. Identify the impacts on the affected parties.
6. Valuate or measure the impacts.
7. Compare the pros and cons of alternative strategies.

In commenting on their chosen approach, the COPEP group noted that Representative Daddario had suggested that assessment should seek to establish cause-effect relationships between a technology and its impacts on society.[36] COPEP found that a "purely causal methodology" had certain limitations. There were in fact, two classes of technology assessment, said COPEP, problem-initiated assessments and technology-initiated assessments. The first, exemplified by the subsonic aircraft noise problem, deals with a large number of variables but is focused on a well-defined

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[36] U.S. Congress, House, Committee on Science and Astronautics, "Technology Assessment," Statement of Emilio Q. Daddario, Chairman, Subcommittee on Science, Research, and Development, 90th Congress, 1st Session, July 3, 1967.

goal, namely solution of the problem. Here identification of cause-effect chains, such as is done using the systems analysis method of engineering, is feasible because "the future course of events is a converging one, where many causal chains converge on one or at most toward a few end-points. The process begins at the large end of a funnel, and the optimum solution to a given problem is at the small end." In technology-initiated assessments (such as those dealing with instructional aids or multiphasic health screening), however,

> "The assessment process begins with the new technology at the small end and emerges as a complex pattern of consequences at the large end. As cause-effect chains diverge, predictability of events diminishes.. Thus the farther that predictions pretend to see, the greater their degree of uncertainty."[37]

Therefore the COPEP study groups tended to convert the technology-initiated experimental assessments into problem-initiated assessments by focusing on a few potential areas of social concern or of social opportunity which might be significantly affected by the subject technology. However, the report noted that this choice was influenced by the constraints of time and effort in making these experimental studies, and warned "The uncertainty in this approach is that in making the selection of problems to be addressed, important social and political impacts could be overlooked."

In carrying out steps 5 and 6 of their experimental methodology, (identification, evaluation, and measuring of impacts

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[37] A Study of Technology Assessment, p. 16.

on affected parties), the COPEP study groups worked out a simple scheme for comparison of the judgments of the assessors. Each assessor rated each potential impact (for example, increased cost of instruction with the use of television) for each affected party (institutions of higher education, students, faculty, industry). Impacts were rated as to their nature (favorable, unfavorable, unknown), their probability of occurrence (likely, unlikely), and their susceptibility to federal action (controllable, uncontrollable, unknown). The limitations of this coarse-grained rating scheme were recognized; but, said the committee:

> "...attempts to apply several (more complex rating schemes) led to the realization that the effort and judgment required to implement them resulted in distinctions that could neither be better supported nor whose combined effects could be assessed more critically."[38]

This difficulty points to a critical need which is consistently recognized in technology assessment studies subsequent to the COPEP report: the lack of an acceptable and accepted system of social indicators for measurement and comparison of potential impacts which have been identified through technology assessment.

On the basis of its three experiments, the committee reached fourteen conclusions.[39] These are paraphrased below.

1. Technology assessments are feasible, and will be useful to Congress "when prepared by properly constituted, <u>independent</u>, <u>ad hoc task forces</u> with adequate staff support and time."

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[38] *Ibid.*, p. 43.

[39] *Ibid.*, pp. 3-5.

2. They should be free from political influence or bias. Selection of a preferred course of action is the prerogative of the legislator; the assessment group should limit itself to outlining alternative strategies for action.

3. Assessors should be chosen for their expertise and not as representatives of affected parties or interests.

4. Assessors must necessarily be chosen from public and private organizations with knowledge about the subject, but organizational biases of the experts will tend to cancel out and be neutralized.

5. There should be extensive participation by behavioral and political scientists; experience shows that engineers, economists, and social scientists can work together harmoniously.

6. To be of most use, the assessment should take about one year and be the sole activity of the research group.

7. Congress would be best served by a small management group which would arrange for technology assessments by diverse research organizations. No one entity can provide adequate in-house expertise for all assessments.

8. Cause-effect analysis should be supplemented by "the intuitive judgments of knowledgable individuals."

9. Assessments can begin through consideration of either a technology, or a social problem. The procedures for these two kinds of assessment will differ somewhat; Congress has a greater

need for the first, while more fully tested methodologies exist for the second.

10. Technology-initiated assessment requires a choice between "diffuse searches seeking some early-warning signal" and "conversion to a problem-oriented study" that chooses the most significant (potentially detrimental) impacts for analysis. The latter choice involves the danger of overlooking hitherto unrecognized impacts.

11. Long-term forecasts (more than five years) are valuable for planning and "setting the stage" for consideration of unforeseen events, but are likely to be unreliable.

12. Criteria for establishing the priority of topics for assessment include the breadth and depth of expected social impact, the visibility of the problems to legislators and to the public, and the current and expected rates of development of the technologies.

13. Appraisal of impacts must include the derivation and use of measures of social value pertinent to the quality of life, in addition to conventional economic and technical risk-benefit criteria.

14. Technology assessment can provide the public support necessary for national programs designed to secure the benefits and avoid the problems of technological advances.

Unlike the COSPEP report earlier described, which indicated a preference for internalized assessments (those integrated into

institutional decisionmaking processes), the COPEP report thus concentrated on the need for externalized assessment, "by properly constituted, independent, ad hoc task forces" of neutral experts. The COPEP study, unlike the earlier efforts, made a clear distinction between problem-initiated and technology-initiated assessments. By clearly preferring the former (because of the existence of familiar and well-developed techniques of analysis for such subjects), and by advocating the conversion of technology-focused assessments into problem-oriented studies, COPEP tended to downplay exploratory, anticipatory assessment at an early stage of technological innovation, when problems have not become obvious and potential consequences have not yet been recognized. This thrust undercuts the greatest value of technology assessment as other advocates, including Mr. Daddario, have conceived it. By focusing on technology-related problems to the almost total neglect of potential benefits, this report stressed the negative aspects of technology assessment and may have fed the anxieties of critics who were, in 1969, already beginning to talk of technology assessment as "technology arrestment." These fears became evident at a meeting which provided the next significant forum for discussion of technology assessment.

1969 and 1970: Discussions and Hearings. Under the aegis of the Engineering Foundation, a non-profit professional association, about one hundred persons met in August 1969 for a discussion of the

three reports which had been generated on technology assessment. Participants included the COSPUP and COPEP members, representatives from the Legislative Reference Service and congressional committee staffs, and engineers and academicians. During the discussions, as one participant, Dr. Franklin Huddle, described the discussion, it became clear that

> "...there was a trend toward the polarization of views into --
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> "(a) Those favoring a formal governmental process..., those concerned with the cooling of technology, and those concerned with ecological/environmental insults caused by technology,
>
> <u>versus</u>
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> "(b) Those determined that the creativity of technology should not be restrained by the straitjacket of assessment and regulation; those attaching high value to the economic importance of continued exploitation of technology; and those inclined to discount as exaggerated the allegation of environmental degradation resulting from technological 'progress'."[40]

Those who take the extreme position that technology assessment may be "a straitjacket" dampening technological innovation and starving scientific research by suppressing public support, cannot be assumed to be callous to societal problems. As one such sceptic wrote, in a paper entitled "Technology Assessment or Technology Harassment?":

> "Considering the attacks to which science and technology are now being subjected, the danger is...that harassment by an overemotional political process may prevent (new

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[40] Huddle, "Government Technology Assessment," p. 26.

technology) from coming to fruition. Such a risk may be run, however, to assure that the new technology will meet its legitimate purpose of serving the public interest."[41]

This author, Dr. Leon Green, Executive Secretary of the Defense Research Board, pointed out in speaking of pollution:

> "What generally goes unrecognized...is that the culprit is not technology _per se_ but persistence in the application of obsolescent (if not archaic) technology for economic reasons, and failure to apply new or existing technology for the processing of waste products. What is needed is not less but more and better technology, thoughtfully applied."

In November and December 1969, the Daddario subcommittee held hearings on the subject of technology assessment.[42] The Comptroller-General of the United States and the heads of the National Science Foundation, the Library of Congress, a National Laboratory, the National Bureau of Standards, and the Office of Science and Technology, described for the subcommittee the readiness and capability of their organizations to provide Congress with technology assessments. Other executive agencies, such as the Department of Commerce and the Food and Drug Administration, provided testimony about the technology assessment activities of their agencies. In addition, there was testimony from representatives of a number of academic institutions, especially those

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[41] Leon Green, Jr., "Technology Assessment or Technology Harassment," unpublished paper presented at a Seminar of the Program of Policy Studies in Science and Technology, The George Washington University, March 26, 1970.

[42] U.S. Congress, House, Committee on Science and Astronautics, _Technology Assessment_, before the Subcommittee on Science, Research, and Development, 91st Congress, 1st Session, Nov. 18, 24; Dec. 2, 3, 4, 8, and 12, 1969.

with programs in the policy sciences, which indicated that the idea of technology assessment had been picked up and explored and was rapidly becoming a new and recognized area for academic endeavor. These groups included the Program of Policy Studies in Science and Technology at The George Washington University, the Program in Science and Public Policy at Purdue University, the Program of Technology and Society at Harvard University (now defunct), and others.

The activities of the Daddario subcommittee had sparked wide interest and the concept of technology assessment was being explored, during 1967-1970, through a flood of articles in science and engineering publications, professional journals, and the general media. An annotated bibliography on technology assessment, prepared by the Library of Congress for the subcommittee in mid-1970, listed 154 articles, documents, and books on the subject.[43]

Thus, when the Daddario subcommittee reconvened hearings in the spring of 1970, the idea of technology assessment had generated wide interest.[44] Public hearings were held in Los Angeles, San Francisco, and Webster Groves, Missouri (at Webster

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[43] U.S. Congress, House, Committee on Science and Astronautics, Technology Assessment, an Annotated Bibliography and Inventory of Congressional Organization for Science and Technology, prepared for the Subcommittee on Science, Research, and Development. 91st Congress, 2nd Session, July 15, 1970.

[44] U.S. Congress, House, Committee on Science and Astronautics, Technology Assessment - 1970, Hearings before the Subcommittee on Science, Research, and Development on H.R. 17056, 91st Congress, 2nd Session, 1970.

College) in March to hear representatives of public interest and citizen action groups, and experts on technological impacts and critical environmental problems. In May and June the hearings continued in Washington to hear discussions of how a technology assessment mechanism to serve Congress might best be structured.

The Daddario Bill proposed the establishment of a Technology Assessment Board to promulgate assessment policy, and an Office of Technology Assessment to serve Congress by initiating assessments, using both the Congressional Research Service and the National Science Foundation to carry out research projects requested by the Board, the Director of the Office, or the chairman of any congressional committee. This bill, H.R. 18469, was introduced by Representative Daddario on July 15, 1970, and subsequently reported out by the House Science and Astronautics Committee. A counterpart bill, S. 4085, was introduced in the Senate at the same time. Another bill (S. 4044) had been introduced by Senator Magnuson a few days earlier, which would establish an "Independent Technology Assessment and Environmental Data Collection Commission" to serve all branches of the government. The Commission, as proposed, would have much the same functions described in Representative Daddario's bill with particular emphasis on providing an "early warning" of detrimental environmental impacts of new technology. This bill was referred to the Commerce Committee of the Senate. No further action was taken on these bills by the 91st Congress.

However the Daddario bill reappeared during the 92nd Congress as H.R. 10243, sponsored by Representative Davis and others. (Mr. Davis had assumed the chairmanship of the Subcommittee on Science, Research, and Development after Mr. Daddario retired from Congress in 1970 to run for another office.) The bill received the unanimous approval of the Committee on Science and Astronautics and was passed by the House of Representatives on February 8, 1972, by a vote of 256 - 118, and sent to the Senate. The bill would establish an Office of Technology Assessment (OTA) to serve the Congress; OTA would not itself perform technology assessments but would initiate and direct assessments through contracts with nonprofit, academic, industrial, or <u>ad hoc</u> research groups. Its independence from the Executive Branch was stressed; as one of its sponsors told the Congress,

> "Let us face it...we in the Congress are constantly outmanned and outgunned by the expertise of the executive agencies. We desperately need a stronger source of professional advice and information, more immediately and entirely responsible to use and responsive to the demands of our own committees in order to more nearly match those resources in the executive agencies."[45]

The original bill called for OTA to be made up of a Technology Assessment Board consisting of two Members of the House, two Senators, the Comptroller-General, the Director of the Congressional Research Service, the Director of OTA, and four public

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[45] U.S. Congress, House, Remarks of Mr. Moshur supporting a bill to Establish the Office of Technology Assessment. <u>Congressional Record</u>, February 8, 1972, H. 867.

members appointed by the President. But in the interest of further independence from the Executive Branch, the bill was amended on the floor so that the Board would consist of five Members of the House and five Senators, with the chairmanship alternating between these two groups. The Director is to initiate assessments only at the direction of the Board or of congressional committees.

A Technology Assessment System for the Executive Branch

Should the Technology Assessment Bill be accepted substantively by the Senate, the Congress will have established a mechanism which will provide Congress with technology assessments independent of the assessment process in the Executive Branch. Congress had already passed, at the end of 1969, the National Environmental Policy Act, discussed in a subsequent section of this chapter, which was designed to improve the planning and evaluation of technological projects and programs by executive agencies. The Subcommittee on Science, Research, and Development had taken one further step in this direction by commissioning a fourth study of technology assessment by the National Academy of Public Administration. This study was concerned with technology assessment in the Executive Branch.[46] This study, which appeared in July, 1970, concluded that "Technology assessment in the Executive Branch now suffers from two major drawbacks: (1) the

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[46] A Technology Assessment System for the Executive Branch. Report of the National Academy of Public Administration to the Committee on Science and Astronautics, U.S. House of Representatives (Washington, D.C.: Government Printing Office, July, 1970).

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II. DEVELOPMENT OF THE CONCEPT OF TECHNOLOGY ASSESSMENT

C. Contextual Approach to Technology Assessment: Implications for "One-Factor Fix" Solutions to Complex Social Problems

Louis H. MAYO

April 1971, pp. 8-26; 38-87

participants, institutions, and social interests significantly affected by the proposed application. Further, each such participant will employ an alternative-oriented decisional model[8] to conduct its analysis of the more promising strategies or courses of action to pursue in order to achieve the desired assessment outcome.

The System of Technology Assessment comes into operation with respect to a given application when prompted by an Initiating Event such as a suggestion, recommendation, or proposal from any participant, public or private, in the System. Or the event may be a crisis or disaster arising from a technological source or within a social problem context for which a technological means is sought for its solution or alleviation. Frequently, a mission-oriented agency will be the initiating entity which sets the System in motion, the proposal growing out of its normal planning or R&D activities. Assuming the usual progression of a promising R&D proposal, the stages will include: Initiation, Assessment/Planning, Decision/Approval by the Executive Branch and the Congress, Implementation, Operations, Continuing Appraisal, and Feed-back. In some instances this Process of Program Implementation is monitored and regulated by an independent administrative/regulatory agency. But continuing monitoring and informal assessments will be made by various entities in the overall System of Technology Assessment/Application. In assessment decisional situations involving the establishment of a statutory

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[8] See Louis H. Mayo and Ernest M. Jones, "Legal-Policy Decision Process: Alternative Thinking and the Predictive Function," 33 Geo. Wash. L. R. 318, 350 (1964).

scheme and an implementing agency, the evolution might be characterized by the phases of the Legal/Policy Decision Process of Intelligence, Recommendation, Prescription, Invocation, Application, Appraisal, and Modification/Termination.[9]

It is apparent in locating the evaluative function in the context of the on-going Effective Public Decision Process that evaluation pervades the entire process. Assessments are performed for a variety of purposes.[10] The evaluation function, including technology assessment, is performed by a great diversity of public, private and public/private sector entities with differing authority, objectives, resources, capabilities, experience, and influence on the decisional process -- evaluation being primarily an intelligence or enlightenment input of relevant data and analyses. Assessment is carried on by participants having perspectives ranging from the most exclusive and partisan to the most inclusive and public interest-oriented. The participants interact in formal and informal forums and in authoritative decisional arenas. The assessment outcomes of a diversity of assessment entities must eventually be evaluated by the ultimate

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[9] Harold D. Lasswell, and Myres S. McDougal, "Jurisprudence in Policy-oriented Perspective," 19 Fla. L. R. 486, 505 (1967).

[10] For example, assessments may be directed to an evaluation of the total social impacts of a specific technological application, or to certain specified effects if the application is considered as a source of social harm or as a means of alleviating an adverse social condition. But the assessment objective might also be to assess alternative technological configurations or alternative applications which will conform to a stipulated future social environment, or to make a comparative assessment of alternative technological applications designed for the same social purpose, or to make a comparative assessment of alternative technological applications designed for different or competing social objectives. For illustrations of various assessments and their particular purposes, see Vary T. Coates, Examples of Technology Assessments For the Federal Government, Staff Discussion Paper 206, Program of Policy Studies in Science and Technology of The George Washington University , January 1970.

authoritative decision makers, such as the agencies of the Executive and the Office of Management and Budget, as well as by the legislative committees and sub-committees of the Congress. It would seem essential to the overall adequacy of the technology assessment function that thoughtful, calculated, and understandable national policies be established which will provide the criteria for evaluation of the social impacts of proposed technological applications. Otherwise, assessment outcomes, with respect to particular programs or projects, cannot be evaluated for adequacy and usefulness by the responsible decision makers. Further, this overall task of assessment outcome evaluation would seem to require some mutuality of accommodation among expressed national policies in the major social-functional areas.[11]

But the establishment of meaningful national policies which can give guidance to assessing entities is no easy task. Of course, the assessor always has the option of measuring effects brought about by the intervention of a technological application in terms of alternative schemes of social interests or of alternative national policy objectives. This approach is useful in setting out policy alternatives where no established policy exists; concomitantly, it may simply stimulate greater divisiveness by supplying analytical support for more sophisticated advocacy.

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[11] See, for example, John W. Gardner, "The Undelivered Message of John Gardner," The Wash. Post, May 16, 1970, p. A 12, col. 3.

> We can't understand our current frustration if we look only at specific substantive goals in education, housing, employment, and the like. What is not working is the process and the mechanisms which should serve us in achieving all of our goals.

Daniel P. Moynihan has asserted that we are moving from a focus on independent programs which "relate to a single part of the system" to policy which "seeks to respond to the system in its entirety."[12] He expects this movement to be a definitive trend in the 1970's.[13] In short, we are giving increasing attention to total social problem contexts or social systems as contrasted with programs directed toward particular parts of such systems which are not coordinated by an overall policy. "(A) policy approach to government . . . (seeks) to encompass the largest possible range of phenomena and concerns."[14] Moynihan cites the 1956 Interstate and Defense Highway System as the "largest public works program in history"[15] and states that the eventual judgment will be that it has "had more influence on the shape and development of American cities, the distribution of population within metropolitan areas, and across the nation as a whole, the location of industry and various kinds of employment opportunities (and in all these, immense influence on race relations and the welfare of black Americans) than any initiative of the middle third of the 20th Century."[16] But he also concludes that "the politics of getting the Interstate Highway Program enacted, decreed, or at least indicated, the narrowest possible definition of its purposes and impact."[17] However one might assess this judgment, it is correct that President Eisenhower's Message to Congress

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[12] Daniel P. Moynihan, "The Concept of Public Policy in the 1970's," Speech given at Hendrix College, Conway, Arkansas, Apr. 6, 1970, p. 5.

[13] Idem at 7.

[14] Idem at 11.

[15] Idem at 15.

[16] Ibid.

[17] Idem at 17.

on the National Highway Program of February 22, 1955, attached the Report of the Presidential Advisory Committee on <u>A Ten Year National Highway Program</u> which focused its attention on the "Nation's highway system, other modes of transportation being explicitly excluded."[18] But within the social sub-system thus posited, both the Advisory Committee and the Report of the House Committee on Public Works displayed an intention to include all significant social interactions and effects of the proposed "National highway system." As the author of this paper has observed elsewhere:

> The Congressional Committee Report shows that an extremely wide range of engineering, financial, and social factors was considered. From our present perspective, however, we would note that some factors were given no attention whatever. The Advisory Committee and the Congress seemed to be much more concerned with the efficient implementation of the highway program rather than with cumulative and qualitative social impacts, particularly those which might be detrimental. No consideration was given to increasing environmental pollution which would result from the growing traffic volume: air pollution from exhausts, engine noise, resulting aesthetic debasement, or the derivative health hazards from the foregoing sources. Nor was a great deal of attention given to the relationship between the increased number and size of motor freight carriers and the possible increased hazards to private auto drivers and passengers.[19]

The above quoted passage should be considered as illustrative of the prevailing public concerns (or the lack thereof) of the middle 1950's, and not as a criticism of the Presidential Advisory Committee and Congressional evaluators. But Moynihan comments with reference to the planning and implementation of the Interstate Highway System by the Bureau of Public Roads:

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[18] Mayo <u>supra</u> note 1, at 18.

[19] <u>Idem</u> at 19.

> As bureaucrats, their instinct was faultless. Had anyone realized what they were in fact doing, the sheer magnitude of the interests they were affecting, it is nigh impossible to imagine that they would have won acceptance. Indeed a bare fifteen years after the Interstate program commenced, it is near impossible to get a major highway program approved in most large American cities. But it is too late: most systems have been built. In the process -- such at least would be my views -- quite appalling mistakes were made, but they were mistakes having to do with issues nominally altogether unrelated to the highway program itself, and so no one was responsible for them....[20]
>
> Surely it is possible to hope for something more. Government must seek out its hidden policies, raising them to a level of consciousness and acceptance -- or rejection -- and acknowledgement of the extraordinary range of contradictions that are typically encountered....Surely also it is possible to hope for a career civil service that is not only encouraged, but required to see their activities in the largest possible scope.[21]

Despite the foregoing suggestions of lack of policy guidance in terms of formulations which encompass broad social problem contexts or inclusive social systems, we do have many commendable policy statements directed to critical social problem contexts in our statutory schemes, as for example: Employment Act of 1946, Housing Act of 1949 and subsequent reiterations, Economic Opportunity Act of 1964, Civil Rights Act of 1964, etc. So the deficiency may not be entirely due to a lack

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20 Moynihan _supra_ note 12, at 17.

21 _Idem_ at 18.

This discussion of the re-assessment of the Interstate Highway Program suggests the question of the extent to which the new National Rail Passenger Corporation, which commences management of intercity rail passenger service as of May 1, 1971, has been evaluated for "total social impacts" with respect to its operations. See DOT Release of Jan. 28, 1971, #2071. See also, Tom Wicker, "Rescuing the Iron Horse," _N.Y. Times_, Sept. 27, 1970, p. 15E, col. 4.

of well formulated policy. It is also a matter of determination to carry out stated policy including the willingness to allocate sufficient resources for the development of adequate planning and assessing capabilities as well as to implementation/enforcement functions.[22]

An intense concern has now emerged for a reorientation of social goals expressed by formulations such as "the qualitative society," a "livable environment," and "balanced social growth."[23] There is definitely a trend,

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22 Joseph A. Califano, Jr., "The Rhetoric and the Reality," The Wash. Post, June 4, 1970, p. A 16, col. 3.

Certain indicators raise serious doubts as to the extent of the public's interest in environmental pollution abatement when actually confronted with the cost. See Sylvia Porter, "You Will Pay For Pollution Controls," in the Wash. Star, Sept. 23, 1970, p. F 6, col. 3.

In an editorial, "Missing the Message on Billboards," The Wash. Post, Sept. 22, 1970, p. A 20, col. 1, makes the following comment:

> One of the funnier games that politicians occasionally play is to pass a law one day and then help break it the next. Except that not everyone finds it funny. In 1965, Congress enacted the Highway Beautification Act which said, among other things, that all billboards were to come down by July 1, 1970, from rural sections of the interstate and primary highway systems. This meant some 800,000 signs bordering 235,000 miles of roadway. Now, five years and two months later, the billboards are still up. What's worse, a fair chance exists that they may stay up.

23 See Institutions for the Effective Management of the Environment, a Report of the Environmental Studies Group to the Environmental Studies Board of the National Academy of Sciences and the National Academy of Engineering, Part I, January 1970.

See also A Strategy for a Livable Environment, a Report to the Secretary of Health, Education, and Welfare, by the Task Force on Environmental Health and Related Problems, June 1967, and the Report of the National Goals Research Staff, Toward Balanced Growth: Quantity with Quality, Washington, D. C.: The White House, July 4, 1970. On the urgent need for "balanced and purposeful growth" see George H. Brown, Director of the Bureau of the Census, "Looking to 1985 - and the Dangers of an Affluent Majority," Washington Post, Dec. 29, 1970, p. A 14, col. 3.

of which technology assessment is but one aspect, to adopt a more "balanced" orientation toward social advance.[24] This involves the development of indicators of social change and the means of measuring and evaluating such change. This orientation toward the introduction of greater rationality into the process of applying resources to social goals obviously involves an increasing degree of selectivity among social goals, deliberateness in choice of means, and criteria for making such determinations.[25]

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[24] A major shift in social value priorities has been urged, that is from a concept of "The machine-conditioned utopia . . . based on power, property, productivity, profit, and publicity" to one of "an organic world-picture in the center of which stands man himself." See discussion of Lewis Mumford's book, The Pentagon of Power (1970) in Business Week, November 14, 1970, p. 6.

"For the first time in the nation's history, environmental questions are figuring importantly in the campaigning in many states in this fall's elections." N. Y. Times, Sept. 27, 1970, p. 1, col. 6.

[25] The strong movement toward the reappraisal of priority social values is reflected in the following statement concerning Robert S. McNamara, President of the World Bank, Wash. Star, Sept. 21, 1970, A 13, col. 1:

> The former U. S. Secretary of Defense hit hard at military expenditures when he told finance ministers and central bank governors from 116 nations, "That 20 times more should be spent on military power than on constructive progress appears to me to be the mark of an ultimate and, I sometimes fear, incurable folly."
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> He said it was "inconceivable" to him that Americans accept a situation in which they form 6% of the world's population but consume 40% of its resources and "contribute less than their fair share to the development of the emerging nations."
>
> McNamara also said population planning is imperative because the world's present population of 3.5 billion would not become stationary until 2120 at which time it would be at 15 billion.

We are moving from a situation of relative randomness to one of social selectivity in technological development.[26] Neither unalloyed technological development nor unrestrained economic growth is any longer assumed an unmixed blessing.[27] Both have been strongly related to and held responsible for a

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[26] "A Nation Seeks its Goals," The Futurist, Vol. IV, No. 4, August 1970, p. 116.

> "This Nation's relationship to technology may be approaching a reorientation as drastic as the apparently impending change of relationship of man to his environment. For the first time, there seems to be a serious commitment to a deliberate and cautious approach to the introduction and use of technology." (Quote from Report of National Goals Research Staff).

The purpose of evaluating the impact of technology is both to enable society to refrain from introducing technology that might do more harm than good and to enable technology to be introduced in such a way that institutional change may be made with greater deliberation.

[27] See Edwin L. Dale, "The Economics of Pollution," N. Y. Times Magazine, Apr. 18, 1970, p. 1, and J. Alan Wagar, "Growth Versus the Quality of Life," Science, June 5, 1970, p. 1179.

See also, Benjamin C. Marble, "Who Needs the SST?" (Review of Technopolis: Social Control of the Uses of Science, by Nigel Calder, New York: Simon & Schuster), Book World Section, The Wash. Post, Sept. 13, 1970, p. 8.

> Calder's witty and well-organized study of the relatively orderly Technopolis we live in now is written to show the consequences of an uncontrolled, world-wide, slavish adoption of the philosophy that more is better. This is a philosophy that assumes the virtues of genetic prefiguration, the superiority of predominately white, western peoples, and all the solutions professed during the past twenty years by the sales-oriented builders of rockets, weaponry and gross national product. Calder knows that something else is needed, and while he doesn't pretend to have all the answers, he asks a lot of the right questions in Technopolis.

policy of unlimited consumption and, hence, as direct contributors to the deterioration of both the social and natural environments.[28] This emerging public attitude that technological resources along with others should be employed to maximize social gains and minimize social costs is reflected in policy declarations such as that of the National Environmental Policy Act of 1969. This Act states in part that we take action "to foster and promote the general welfare, to create and maintain conditions under which man and nature can exist in productive harmony. . . ." Such concepts as "social indicators," "social systems analysis," and "technology assessment," represent the analytical dimension of this quest for a new value orientation.

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[28] Hans H. Landsberg, "Villains Obscure Some Real Keys to Pollution," The Wash. Post, Apr. 26, 1970, p. B 3, col. 1.

> For it is high per capita consumption based on high per capita income, combined with a sophisticated and powerful technology, that accounts for the major facets of environmental pollution in the United States today. Behind technology and income, size and growth of population run a poor third.

II - Contextual Approach to Technology Assessment

What is the critical change in our conceptual approach and supporting analytical techniques that is implied in the previous discussion? Basically, it is the need for an inclusive, comprehensive concept of the evaluative function in the planning and development of new programs and projects, technological or otherwise, in the support of national policy goals.[29]

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[29] See Mayo, supra note 1, at 5.

Consider also the following statement:

> People have long known that technology can have undesirable second-order consequences, the Goals Staff says. What seems to be new is:
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> 1. Technology is becoming both more voluminous and more complicated.
>
> 2. The complexity of much new technology makes it more difficult to anticipate how it will do its primary job.
>
> 3. As our understanding of biological, ecological, economic, and social processes improves, we are struck with the complexity of the consequences which technology can produce.
>
> 4. We have a growing determination and belief in our capacity to evaluate the second-order consequences of all our actions, including the use of technology, and to include their costs in our policy making process.

"A Nation Seeks Its Goals," The Futurist, August 1970, p. 116.

Another variation is presented in the statement of Charles J. Zwick, President of Southeast Bancorporation, Miami, Florida, in Economic Analysis and the Efficiency of Government, Hearings before the Subcommittee on Economy in Government of the Joint Economic Committee, 91st Congress, 1st Sess. Part 1: Aug. 12; Sept. 16 and 19, 1969, p. 165:

> Simply stated, congressional interest and capacity are absolutely essential to major advances in the executive branch of Government, because of this interaction between congressional interest and the focus of the senior officials in the executive branch.

As we have seen, this involves the recognition that numerous participants having different objectives, resources, and capabilities interact in various forums and decisional arenas and that these interactions can lead to lost opportunities as well as serious social detriments if left unexplored. Such interactions among participants, institutions, and social values may be conceived of as a social system. A system, however, is often perceived as a relatively stable pattern of interactions which can be identified and displayed, schematically or otherwise, by cybernetic feed-back loops. Perhaps it is more useful in the present state of the art to think of a "total social impact" or "contextual" approach to technology assessment rather than in terms of inclusive, comprehensive and highly sophisticated "systems" with

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29 (continued)
A second major area for improving analysis capability of the Government is additional work on the distributional impact of programs. In brief, how does the program affect various regions and client groups? Most analyses have ignored these issues. (Italics added.)

Economists, in particular, like to emphasize the efficiency aspect of a program, ignoring the distributional impact of program changes. If I learned anything in my three and a half years in Washington it was that Members of Congress are very much concerned with distributional impact. How does it affect their constituents in particular, and more generally, given their basic political orientation, what groups are favored and what groups are disadvantaged by a special course of action?

The distributional impact of policy changes should be a standard requirement for an analysis effort. In the excellent volume the committee produced earlier this session, Professor James T. Bonnen of the Michigan State University discusses this problem and points out that it is almost impossible to find data on distributional impacts of Federal programs. But until analyses provide information on this issue, they will continue to be politely received and then set aside as not completely relevant to the serious business of congressional decisionmaking.

all feedback loops meticulously incorporated in the analytical model. On the other hand we need not close our eyes to the fact that we are dealing with social systems. The social impacts of an application on participants, institutions, processes, and social interests, and the accompanying interactions may not only induce modifications in the problem context delineated for examination with respect to the design, operations, regulation, and use of the posited application, but also affect related social problem contexts. Changes induced in other social systems may ultimately feed back into and affect the primary social problem context.

Attitudes toward and concepts of the evaluative function will certainly differ.[30] But in any event, the contextual approach of

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[30] No doubt the controversy will continue for sometime over the advantages and limitations of decisions based on the intuition of experience on the one hand the rational/contextual approach on the other. Kenneth Boulding has stated that:

> The great danger of rationality is of course suboptimization, that is, finding and choosing the best position or part of the system which is not the best for the whole. Too many people, indeed, and especially too many experts, devote their lives to finding the best way of doing something that should not be done at all. Decision making by instinct, gossip, visceral feeling, and political savvy may stand pretty low on the scale of total rationality, but it may have the virtue of being able to take in very large systems in a crude and vague way, whereas the rationalized processes can only take subsystems in their more exact fashion, and being rational about subsystems may be worse than being not very rational about the system as a whole. I would not argue, of course, that rationality about the system as a whole is impossible. On the other hand, the economist has a certain mind-set in favor of his own skills, and it is easy for him to leave out essential variables with which he is not familiar. Here, indeed, a little learning may be a dangerous thing, or even a little rationality.

attempting to trace through systematically, insofar as practicable, the full social implications of a technological application as it affects participants, institutions, resources, and social interests, seems a definite advance over narrowly defined and exclusive "systems" which have characterized most assessment efforts in the past.[31]

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30 (continued)

Kenneth E. Boulding, "The Economics of Knowledge and the Knowledge of Economics," Paper given at the American Economic Association, Dec. 29, 1965, p. 14-15.

Consider the following statement by Daniel P. Moynihan:

> I refer to what Jay Forrester has termed the "counter-intuitive" nature of social problems. We learn to think, Forrester assures us, in simple loop systems. Social problems arise out of complex systems. The two are not alike, so it is asserted by men who ought to know. There are fundamentally different properties, such that a good common sense judgment about the one will lead with fair predictability to illusions about the other. Thus Forrester: "With a high degree of confidence we can say that the intuitive solution to the problems of complex social systems will be wrong most of the time."

Moynihan, supra note 12, at 20.

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See in this connection Garrett Hardin, "To Trouble A Star: The Cost of Intervention in Nature," Bulletin of the Atomic Scientists, Jan. 1970, p. 20:

> Economics employs partial analysis to reach its decisions. This defect is not essential to the subject of economics, but it is traditional. Because of the increasing pressure of population and because of our greater knowledge of the consequences of our actions, economics is being rapidly altered away from its classical mold in the direction of ecology. The public interest in every proposal will in the future weigh more and more heavily in reaching decisions on the expenditure of public moneys. Cost-benefit analyses must be carried out within an intellectual framework that comes closer to incorporating the total system.

Policy statements in statutory schemes and executive orders usually set forth broad social objectives. Such policies are in turn supported by one or a variety of programs and projects directly and indirectly through programs designed primarily to serve related social policies. Policy guidance with respect to national social goals therefore provides the measurement standards which would be employed (at least as one scheme of social values) in a total social impact assessment of a particular program or project. As is evident, however, from the previous exposition of the Effective Public Decision Process and the System of Technological Assessment/Application, a comprehensive framework for technology assessment of a major intervention into the social process will involve a sequence of analytical operations of which a national social policy or policies will provide only one of multiple inputs.

Recognition of the need for a reinforced technology assessment function and its regularized application is only the first phase of what must be a continuing process. The really critical point is the adequacy with which assessments are performed. The notion of adequacy can be understood only with an appreciation of the full scope of operations involved in the assessment process.

Assessment tasks can be expected to differ considerably depending upon many factors, such as the study parameters set by the sponsoring agency or by the initiating assessment entity, by the nature of the particular application, and by the resources of the assessing entity. Hence, we can anticipate a variety of assessment methodologies. If we assume for present purposes that a major new technological application

or alternative applications (such as transportation modes for linking large metropolitan areas) are proposed for introduction into a future social environment, then it would appear that the following types of organizational/analytical operations are essential:

Preparatory Phase:

- Tentative specification of the time sequence of tasks to be performed in order to achieve the objective of the assessment.
- Provisional organization of the assessment group staff into Social Impact Task Units related to social sub-processes (institutional-value contexts) as contrasted with conventional academic disciplines or professional identifications. For example:
    - Effective Public Decision Process (National and International)
    - Economic Institutions and Processes
    - Knowledge and Skill Institutions and Processes
    - Urban and Regional Developmental Processes
    - Social Behavioral Patterns: Standards of Conduct, Interpersonal Relations, etc.
    - Processes for Exercising Volitional Options in the Social Environment: Well-being: Access to goods, services, etc.
    - Processes Affecting the Quality of the Natural Environment
- Instruction of the assembled staff in the overall methodology of the study and techniques for evaluating social impacts.

Execution Phase:

- Establishment of baseline data on the existing Social Environment.
- Establishment of baseline data on the R&D status of the relevant technology or technologies.
- Projection of future social environments within the prescribed time frame: extrapolations, deliberate interventions, and contingencies.
- Imposition of the proposed technological application (or alternative applications) on the projected future social environments.

- Identification of the significant effects or changes which will necessarily, probably, or possibly occur during the initiation, implementation and operational stages of the application (or applications).

- Selection of those effects to be fully analyzed and evaluated to determine the social impacts of the application.

- Identification of the participants, institutions, processes, and social interests affected by the changes brought about by the introduction of the application into the projected future social environments.

- Social impact analysis of such effects in terms of their probability, magnitude, duration and social desirability or undesirability with respect to the affected participants, institutions, processes, and social values.

- Measurement of the social impacts in such manner (as aggregates or particularized) as to render them usable inputs into a rational decision process.

- Presentation of the assessment outcome in terms of 1) an overall social cost/benefit ratio; or in terms of 2) critical policy issues which take into account the significant changes flowing from the technological intervention and the social impacts resulting therefrom; or by 3) the alignment of basic findings with R&D requirements and with further social impact assessment needs.

The foregoing operations seem logical and straightforward, but one must be aware of the uncertainties and difficulties involved in certain of the operations, particularly the evaluation of social impacts. Various projections must be made. Not only must technological development forecasts be made, but assumptions are required with respect to the conditions of operation, managerial skills to be applied, and the reaction to such operations by those who will be affected. Models of the manner in which participants (individuals and organizations) will behave or be expected

to behave must be posited. Serious deficiencies now exist in our capability for "future-oriented" thinking.[32]

Further, the degree of social impact will depend upon the extent of use, or what is assumed to be the extent of use, of the subject technology. We have often in the past probably seriously underestimated the scale of application (private automobiles, television, etc.).[33] The scale of use varies with such factors as the perceived utility, the affluence of the society, and the number of people or entities in the "market." The aggregate use of technologies by an American citizen is many times greater than that of the average Indian citizen. Hence, the

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32 On the need to develop new professional skills to diagnose complex social systems in modern, dynamic society, see Edgar H. Schein, "The Role Innovator and His Education," Technology Review, October/November 1970, p. 34. See also, Erich Jantsch, "Planning and Designing for the Future," Futures, September 1969, p. 440.

33 The automobile had a relatively slow start. See the interesting discussion of the evolution and impact of the automobile on American society by Samuel Eliot Morison in The Oxford History of the American People, The Great Change 1907-1939: "1. The Auto and the Ad Man," 419 (1965).

To introduce a touch of humor into our predictive capability, or better, fallibility, we might reach back even further and consider a quote from Scientific American for July 1899 which appears in Reason Awake: Science for Man by Rene Dubos (1970), p. 95.

> The improvement in city conditions by the general adoption of the motor car can hardly be overestimated. Streets clean, dustless, and odorless, with light rubber-tired vehicles moving swiftly and noiselessly over their smooth expanse, would eliminate a greater part of the nervousness, distraction, and strain of modern metropolitan life.

potential for both technological abuse as well as technological benefit is far greater in America than in India.[34] From the foregoing discussion it is apparent that there are limitations on what can be expected from Technology Assessment. But this much can at least be said: Technology Assessment can alert all affected participants to the probable social impacts of a given application under specified conditions.[35] This in itself is an advance toward more rational social behavior.

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34 See W. H. Davis, New Republic, Jan. 10, 1970, p. 13; also Frank S. Hopkins, "America and the World: The Future," (Address delivered at the 2nd Annual Institute of Sociology at Muskingum College, New Concord, Ohio, March 8, 1970), in an attachment to the World Future Society Bulletin, Vol. III, No. 9, Sept. 1970, p. 3.

35 See generally Lederberg, Joshua, "TA Can Help Prevent Some Historic Mistakes," Washington Post, January 24, 1971, p. B 2, col. 1.

IV - Social Problems and the "Technological Fix"

The previous section has alluded to a variety of questions which would be posed and examined in a comprehensive assessment of the probable future implications of an adequate technology assessment function. This section will be limited to a discussion of special aspects of the potential implications of assessment outcomes for social action programs. Specifically, what might be the implications for the selection of means of coping with social problems and how will such means (in particular technological applications) be related to or integrated with prescriptions concerning control over the mode of introduction, manner of operation, and restrictions on the use of resulting products or services? This formulation encompasses two topics which have usually been treated separately: 1) the impact of a reinforced assessment function on technological innovation and 2) the concept of "technological fix."

One of the principal arguments that has been made against an enhanced technology assessment function is that it will have an inhibiting impact on technological development.[49] While it certainly may, in given instances,

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[49] The National Goals Staff cautioned that:

> Technology assessment must not become "technology arrestment . . ." Fortunately, parallel to the technology assessment movement, there is an emerging "technology transfer" movement dedicated to finding a fuller range of uses for existing and new technology.

"A Nation Seeks Its Goals," The Futurist, Aug. 1970, p. 116.

See also, Leon Green, Technology Assessment or Technology Harassment?: The Attacks on Science and Technology. Paper presented at Professional Seminar Series on the Processes of Technology Assessment, The George Washington University: Program of Policy Studies in Science and Technology, #8, Mar. 26, 1970.

have limiting implications as to how or when or where a technology is to be applied and to the level of operations, one of the main contentions

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49 (continued)

The following views of Edward E. David, the President's science advisor, are relevant to this matter:

LOSING OUR NERVE TO EXPERIMENT?

Edward E. David, Jr., the President's science adviser, believes this country is losing its technological nerve.

David told a science writers seminar last week that the American public is becoming increasingly alienated from rational ways of thought. "There are many evidences that society does not believe that technology can be controlled in a rational way," he said. "Because of that, society is losing its courage to experiment. This trend leads to disaster for it divorces our decision-makers from reality."

David said that "we must not place limitations on biological experiments" despite warnings from such eminent scientists as James D. Watson, Harvard Nobelist, that genetic engineering may lead to test-tube babies and a host of ethical and social problems. David also reiterated his opinion that we should build two prototype supersonic transports (SST's) to determine whether the technical and environmental problems can be overcome so that it becomes feasible to build a fleet of SST's. Finally, he cited the negative reaction given by the National Academy of Sciences to suggestions by Nobelist William Shockley that research should be performed in an effort to identify characteristics peculiar to different races.

"Make no mistake," he said, "a limitation on experimentation in whatever cause is the beginning of a wider suppression. When we fail to experiment, we fail. In failing, we bring the best part of American society as we know it today to a halt.

"Already we see timidity in new undertakings," David continued. "We require overanalysis before we are willing to find out what are the real possibilities. If these trends progress, our society will become dull, stodgy, and altogether stagnant." --P. M. B.

Science, March 5, 1971, p. 875.

made herein is that technology assessment may have far more serious implications for general social behavior, individual and organizational. It is not just the technological/industrial sector which may experience limitations on the promotion of an ever-expanding market through population growth and the stimulation of demand through advertising, lobbying activities, and political manipulations.[50] Almost all segments of society will in some measure be affected, beneficially and adversely, in this effort to apply science and technology like other resources in the rational pursuance of priority social needs. In many areas, R&D for technological progress should be expedited, not slowed.[51] We certainly need some alternative to the conventional internal combustion engine and a quieter aircraft jet engine. We need better means of public transportation, better means of waste disposal, better housing and sanitary facilities

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50 Robert Gomer, "The Tyranny of Progress," Bulletin of the Atomic Scientists, February 1968, p. 4, 7.

> For the technological revolution, negative feedbacks have so far been feeble or lacking, in large measure, of course, because the gains have been enormous and visible; the ill effects have been slower to make themselves felt, and have been obscured or justified by the gains. On the other hand there are strong positive feedbacks which tend to spur uncontrolled, unplanned expansion. Chief of these is economic pressure -- pressure for doing things most cheaply regardless of ultimate cost to the society, and pressure for stimulating population growth in order to increase consumer markets.

51 We have hardly begun to make effective use of cybernetic concepts, automatic data processing, and simulation techniques. See the various suggestions in: John S. Saloma, "System Politics: The Presidency and Congress in the Future" Technology Review, December 1968, pp. 23-33; and E. S. Savas, "Cybernetics in City Hall" Science, May 29, 1970, p. 1066.

for much of our population. But perhaps we do not need to drive a private auto as much; or live as close to airports; or dispose of so much trash; or continue uncoordinated zoning practices; or abide archaic institutional positions which stand in the way of introducing needed socio-technical innovations; or expand the population without limit.[52]

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[52] The number of cars, trucks and buses registered in this country is increasing twice as fast as the human population, according to figures released by the Department of Transportation.

"Vehicles Outpacing Human Population," N. Y. Times, Sept. 20, 1970, p. 85, col. 1.

One observer views the matter in the following perspective:

> In summary, the new religeocology to date promises more soporific than salvation precisely at that time when salvation may be rapidly escaping attainment. This situation will continue so long as politicians and other leaders see the ecology crusade as merely a way in which basic problems and schisms can be forgotten and as long as citizens insist upon life as usual with a minimum of disruption and inconvenience. However, as the recognition of the real nature of these problems develops in many groups and the ecology crusade begins to seek radical solutions, we can anticipate a heightened politicization of the issues and an increased conflict with vested interests and privileges. Americans should not be afraid of this possibility, since that is the direction in which true salvation may lie.
>
> For example:
>
> | Ecological Problem | Religeocology Answer | Radical Questions |
> | --- | --- | --- |
> | Automobile Pollution | Clean up the exhaust of the car; support private enterprise in this attempt. | Shouldn't we consider abandoning the automobile as a meaningful mode of mass transportation? Even if we clean up exhausts, what about traffic congestion, noise, accidents, and the disposal of abandoned cars? |

Lowrie, Ritchie P., "The New Religeocology: Salvation or Soporific?", Social Policy, July/August 1970, pp. 46, 48.

Presumably the great benefit of technology is that it provides an increasingly effective and flexible means of satisfying human needs and aspirations; it provides -- or should provide -- for an ever improving social environment, not merely a greater selection of technological options. Technology assessment is advanced as a means by which we can better employ technology for expanding social options such as access to goods, services, and the enjoyment of social-cultural amenities.[53] But some observers

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[53] In this connection consider the following comment on the views of Buckminster Fuller in the Wash. Evening Star, Oct. 23, 1970, p. B 1, col. 3:

> Basic to the game is Fuller's idea that mankind still functions -- badly -- on the Malthusian concept of scarcity of resources. This concept, he believes, is the phychological underpinning for nation-states and the cause of such things as "pollution." Such local political units and problems will disappear, he predicts, when men become aware of the availability of natural and man-made resources on a worldwide basis.
>
> TECHNOLOGY TO ACT
>
> Most importantly, perhaps, Fuller obviously believes man now possesses the technology to act, once he is provided with information on the scale that the computer has made possible.
>
> The results of the World Game, he says, will be to enable "all humanity to enjoy the whole planet Earth without any individual profiting at the expense of another and without interference with one another."

Of course, action programs following from certain persuasive assessment outcomes could in fact reduce certain kinds of social options (in terms of individual choice), i.e., imposition of birth control regulations or restraints on land use.

suggest that since we have let technological innovation, application, and use, expand without heeding the full social consequences, it is already too late to introduce a strengthened assessment function.[54] Of course, it is not too late for this effort, but it may very well be too late for us reasonably to expect a continuing enlargement of social options during the short term.[55] Assessment outcomes over the past few years have clearly

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54 See Moynihan supra note 12, at 18; and consider the review of The City by John V. Lindsay (New York City: Norton Press, 1970) in which Harold Lavine states:

> Yet, as every New Yorker can attest, the city is becoming more and more unlivable -- even for the upper middle class. Crime in the streets is steadily increasing; the streets themselves are becoming dirtier and noisier; and traffic, more and more tangled; the schools are continuing to deteriorate, and heroin addiction among the young has grown alarmingly in middle-class neighborhoods. More important still, the feeling of helplessness and of alienation is spreading.

"Book Review Section," Saturday Review, Apr. 11, 1970, p. 25.

55 For a stimulating discussion of possible impending crises over the next few decades see John Platt, "What We Must Do," Science, Nov. 28, 1969, p. 1115.

As far as the long term is concerned, Frank S. Hopkins comments in "America and the World, The Future," (Address delivered at the 2nd Annual Institute of Sociology at Muskingum College, New Concord, Ohio, Mar. 8, 1970), in an attachment to the Bulletin of the World Future Society, Vol. III, No. 9, Sept., 1970:

> I am more optimistic about 2001 than I am about 1984, since it seems to me that we have more options open for the more distant date and more lead-time in which to set in motion necessary social reforms which will be vital to our destiny. p. 6.

Hopkins is less optimistic about the near future:

> But when I think about 1984, I find myself beset with many gloomy thoughts. It seems to me that it is going to take the leaders and policy-makers of the world, prodded on by all thoughtful people,

demonstrated that severe curbs must be imposed on the application and use of certain technologies if we are not to greatly diminish certain desirable social conditions, such as a non-polluted environment which we have enjoyed in the past. This does not necessarily inhibit technological innovation as a continuing process. It may mean that the direction of future R&D will be subject to certain guidelines or constraints. And it could mean that the operators-managers and the users-consumers will find certain traditional areas of autonomous, volitional behavior severely constricted.

Technological applications surely contribute to the enjoyment of life, i.e., recreation, mobility, health services, etc. But it is also apparent that modern medical technology has helped sustain a growing population.[56]

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55 (continued)
most, if not all, of the next 14 years to change their attitudes toward the future. Mankind must learn to think in completely different terms from the ideologies of the past if our civilization is to survive. In the next 14 years we must change many of our traditional value systems and execute many basic social and political reforms. This will not happen automatically. We are going to have to endure many grave crises before we make up our American and global minds as to the nature of our problems and challenges and the kinds of policies we are going to have to pursue. In short, things are going to have to get worse before they get better, and 1984 may well be just about the low point, the true nadir, of the history of Western civilization. (p. 9)

56
Egypt, like developing countries around the world, is undergoing a runaway population growth as a result of the impact of improved health care, medicines, vaccines, disinfectants and insecticides in reducing centuries-long high death rates.

Raymond R. Anderson, "Egypt Turns on Her Internal Enemy: The Birth Rate," N. Y. Times, Mar. 29, 1970, p. 4, col. 1.

Our increasing population, while demanding the products and services provided by modern technology, in turn produces much of the environmental pollution incidental to the use of such technologies. This consumer pollution is supplemented by the wastes and pollutants of the industries essential to produce the desired consumer products and services. Hence, we are confronted with an ascending spiral of technology, population, and pollution.[57] Might advancing technology itself provide the means by which we can extricate ourselves from a seemingly hopeless situation? Waste water can be recycled, purified and reused. An electric-powered auto could replace the gasoline combustion engine and substantially abate air pollution. But while we may be able to clean up waste water by purely technological means without causing serious immediate or long-term side-effects, it is not so clear that an efficient and economical electric car could replace the internal combustion engine within a brief time span without serious dislocations in the economy. The existing institutional structure, including manufacturers, component suppliers, dealers, fuel and repair servicing organizations, and related activities of lending institutions, insurance companies, and consumer groups can hardly be phased out or drastically restructured over a few years without serious social costs.

The technology assessment function will ultimately not be judged from the standpoint of the degree of control imposed on technological innovation but by the measure of its contribution to the advancement

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[57] S. Fred Singer, "Calculating the Best Population for U.S.," The Washington Post, Feb. 22, 1970, p. D4, col. 1.

of major national goals. The latter, broader standard of performance of the assessment function clearly encompasses some degree of guidance or control over society's use of technology. A regularized assessment function would not likely introduce a serious inhibiting factor on research activity or even on applied research to the development stage. But the assessment function would probably lead to much closer scrutiny of the likely effects which would be produced by new technologies as they are moved into the implementation and operational stages. Conceivably such appraisals could feed back into the R&D process and diminish the aggregate level of R&D resources. On the other hand, the assessment function may have no effect on the level of research and development activity but rather on the type of R&D undertaken. Much more study and experience will be needed before such questions can be satisfactorily answered. But as heretofore stressed, the impact of the assessment function on the process of technological innovation cannot be viewed apart from the social contexts in which the application operates or is to be introduced. These contexts involve <u>people</u>, their functions, desires, and associations. Technology assessment must apply models of how all affected participants will behave in response to the introduction of an application into a future social environment through the initiation, implementation, and operational stages of the new application. Significant participants will be circumscribed in their own sub-context of other interacting participants with given functions, objectives, resources and constraints, and available forums and decisional arenas in which claims are asserted for preferred outcomes. Radiating effects are of all kinds, certainly not restricted to simple, direct cause-effect relationships.

The basic lesson which will most likely be driven home by a vigorous technology assessment function is that the correction of a social dislocation, or the achievement of a new, significant social objective, will involve an intricate context of interrelated participants, institutions, processes, and social interests. We know this, supposedly, but we do not always talk as if we do and we seldom act in accord with this obvious proposition. For example, we still tend to talk in terms of a "fix," technological or otherwise, as if there are unlimited potentialities for one-factor solutions to complex social problems. But as noted, assessment outcomes will most likely be translated into social action programs which will have far-ranging implications, including deprivations, on numerous entities, population segments, and institutional frameworks -- not solely on the technological system. There may be situations in which the solution or the alleviation of a serious social problem will revolve around a technological innovation or can be provided by a legal intervention, or by economic manipulations. But most solutions will require an articulated combination of means.[58]

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[58] De Jouvenel seems to agree:

He warns "against a mindless extension of forecasting practices from narrow technical problems where they may be applied, almost automatically, to more complex social and political realms where there must be a premium on wisdom and sophisticated insight."

"Only through profound insight into the political process and the transformation of ideas can we progress to sound estimates of social change on a large scale. Thus planning is not for technocrats but for humanists deeply respectful of the human condition and its social manifestations."

The crucial import of the contextual approach to technology assessment is that the one-factor "fix" for social problem abatement or solution should be approached with some degree of caution. But this is not to dismiss the notion of the "technological fix." Indeed, if a single means appears to provide an approximate solution to an existing problem or the achievement of a social objective, then the accompanying economy of effort and sharpness

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58 (continued)
Philip C. Ritterbush, reviewing The Art of Conjecture by Bertrand de Jouvenel, in Bulletin of the Atomic Scientists, November 1967, p. 34.

Those who have undertaken to analyze complex social problem areas recognize the need for the contextual approach:

> Resolution of the Florida jetport question with least environmental cost the study group found required consideration of population growth and location, protection of water supplies, proper allocation of resources for agriculture, sound development of public transportation, insurance of attractive living conditions, and "protection of . . . unique national resources." The diversity of considerations necessarily involves a multiplicity of agencies whose decisions contribute to an environmental effect; this is the governmental lesson drawn from the case study and addressed in the report.

"An Unusual Study Points to Institutional Complexities in Environmental Management," News Report of the National Academy of Sciences and the National Academy of Engineering, February 1970, Vol. XX, No. 2, p. 8.

A total social impact approach has apparently now been taken with respect to the siting of electric generating plants. See the Report on Electric Power and the Environment (1970) sponsored by the Office of Science and Technology. This Report is discussed in "Land Use: Congress Taking Up Conflict over Power Plants," Science, Nov. 13, 1970, p. 718. It is also evident that weather modification and control will involve far more than a "technological fix." See references to the international organizational aspects of this matter in "The U. N.'s Coming Role: Internationalizing Technology," The Wash. Post, Nov. 15, 1970, p. B 6, col. 3.

of purpose may offer substantial advantages over a more elaborate "socio-political" process solution. The unique advantage in the "pure" technological fix is that it solves or minimizes a problem by changing the environment rather than human behavior. As noted previously, however, the import of the contextual approach is that some measure of control over human and organizational behavior must usually be applied along with other means in dealing with difficult social situations.[59]

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[59] Even a specific means (fix) for problem solution or program implementation may need to be implemented through coordination of a variety of jurisdictions or agencies having both public sector and private sector characteristics or components. Murray L. Weidenbaum in "Toward a Modern Public Sector," The Conference Board Record, September 1970, Vol. VII, No. 9, p. 17, 21 states:

> The Post Office Department and the Railway Express Agency both deliver parcels; again, one is public and the other private.
>
> The mixed economy that is now developing is different. It is characterized by mixed organizations, each of which possesses characteristics of both public institutions and private organizations. The most obvious examples are the large defense contractors and the not-for-profit research laboratories that do most of their business with the Federal Government.
>
> The modern public sector that is developing is hardly something aloof and entirely separate from the private sector; rather, in its usual pragmatic fashion, the United States is fashioning policy tools not for the sake of their intrinsic beauty, but to achieve a growing variety of difficult and far-reaching national objectives.
>
> It would appear likely that in coming years increasing proportions of Federal funds will be disbursed via state and local governments, inter-governmental agencies, government-oriented corporations, quasi-private institutions, and perhaps even newer organizations possessing both public and private characteristics. The typical Federal Agency indeed will probably be a policy formulator and overseer of programs dealing with operations which have been decentralized in a variety of ways and over a wide span of the American economy. This will provide a very considerable strength and resiliency to American institutions during a period of substantial stress and change.

Further, the notion of a "fix," technological, legal, economic, medical, etc., smacks too much of the narrowly focused social process models of the conventional academic disciplines and professions.[60] These models tend to be partial, distorted, and artificial, and are far more suitable to the display of specialized esoteric professional skills than to adequate social problem analysis. In this connection Kenneth E. Boulding has stated:

> At the basis of the whole general systems enterprise is a faith, if we might call it that, that the empirical world is one, and that the division into different disciplines is more a property of the subculture of science than it is

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[60] The normal connotation of a "fix" seems inconsistent with the observable dynamics of the ongoing social process. Donald A. Schon asserts that:

> The practical consequence of the loss of the stable state is that we must see any programmatic solution to a problem as a learning system capable of shifting over time; no solution can be effective if it carries with it an organizational, institutional or programmatic definition pertinent only to the state of affairs at the time the program was invented.
>
> The principal problem of design is the design of learning systems, or systems able to transform their own behavior over time.

Schon, Donald A., "Implementing Programs of Social and Technological Change," Technology Review, February 1971, p. 48, 49.

Schon rejects "once-and-for-all" solutions to social problems and the mythology that there is a "one-to-one correspondence between the problem and its solution". Idem at 49. He seems to favor an approach described as "an incremental system which consists of a set of short-range solutions, tied to a monitoring of people's behavior in relation to those solutions. . ." Idem at 51.

Apparently lawyers and "politicians" can be just as addicted to the "quick-fix" approach as technologists. See quote in "Environment Unit Shifting Emphasis: City Control Board to Put Politics Before Science," N. Y. Times, Sept. 27, 1970, p. 64, col. 1.

a reflection of any properties of the empirical world. One may perhaps back down a little from that grand statement and suggest that there are different systems levels, at least in regard to degree of complexity, within the empirical world, so that the division of disciplines by systems levels would not be wholly arbitrary. One might perhaps distinguish four or five systems levels of the empirical world -- the physical, the biological, the psychological, the social, and if we are very ambitious, we might add the transcendental. Within each of these levels the traditional boundaries between the disciplines are rapidly becoming fuzzy.[61]

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[61] Kenneth E. Boulding, "General Systems and Interdisciplinary Studies," p. 2-3, in Richard F. Ericson, (ed.), Toward Increasing the Social Relevance of the Contemporary University (Scheduled for 1971 publication). One of a series of essays deriving from the 1968-69 Interdisciplinary Systems and Cybernetics Project, Program of Policy Studies in Science and Technology, The George Washington University.

The influence on economic thinking is postulated by one observer as follows:

Economics, as it has been practiced by most economists since the time of Adam Smith, has had as its purlieu the customary arrangements of systems. The systems in question have been the subsystems of individual business enterprises. Those who paid the piper called the tune. With some exceptions, economists have assumed that "whatever is, is right," to quote William Graham Sumner, who was quoting Alexander Pope. Ecology, neither so fortunate nor so unfortunate as to have patrons, has taken a larger view. The ecologist studies all imputs and outputs, regardless of who pays for them or who benefits by them. In the past, the ecological eye has been focused only on nonhuman economic situations. The focus is now changing as ecology engulfs economics.

Logic dictates this engulfment, but logic alone does not determine history. Power relationships also must be favorable. I think the power relationships now favor a change. In the past, economics was to a large extent the handmaiden of business. The vast majority of economists were either employed directly by businesses, or had jobs in university departments of economics that were unusually sensitive to business interests. In recent decades, the steady increase in the number of economists employed by governmental and quasi-governmental agencies points toward the day when the tunes played by economists will be different. A different sector of society is

How then should we evaluate the potential of the "technological fix" as a resource-means for achieving "balanced" social development? The term "fix" with respect to social problem management suggests a complete or essentially complete solution by means of a one-factor operation, i.e., auto self-starter to remove the effort and dangers of cranking, telegraph to avoid delay in long-range communications, incinerator to remove solid wastes (though it produces air pollution), development of the fusion process to provide an unlimited, economical supply of electrical energy, development of a "quiet engine" to remove or substantially abate jet engine noise, etc.[62]

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61 (continued)
paying the piper. Whether this means that economists will enjoy greater intellectual independence is not clear and may well be doubted. <u>However, the shift in the balance of power should favor the development of a broadly ecological view among economists and that will be a social gain</u>. (Italics added)

Garrett Hardin, "To Trouble a Star: The Cost of Intervention in Nature," <u>Bulletin of the Atomic Scientists</u>, January 1970, p. 18.

62
In his article, "Political Arenas, Life Styles, and the Impact of Technologies on Policymaking," <u>Policy Sciences: An International Journal</u>, No. 3, Fall 1970, p. 275, 277, Dean Schooler states:

> <u>Physical technologies</u>, stemming from and produced by the physical, medical, biological, and engineering sciences, involve an operating system comprised of material, nonbehavioral components. These technologies are external to individuals and groups and at most merely require those individuals or groups to passively use them or allow their use. Specific physical technologies, many already built into public policies or hailed as "quick technological fixes" to social problems, include the "pill," air conditioners, automobiles, weapons, drugs, street lights, teaching machines, gene controls, antismoking pills, new fuels and food sources, personality control drugs, smog control devices, rainmaking procedures, desalination techniques, mace, and seat belts or air bags for automobiles.
>
> <u>Behavioral technologies</u> involve not mechanical or chemical techniques but rather types of human relationships and behavior (9). Behavior, personality, social relationships, or individuals and groups' store

But technology is only one means (resource) for solving, abating, or controlling social problems, including those of which one or a combination of technological applications may be the major cause. So why stress the potential of the "technological fix" as contrasted with a "legal fix" or "economic fix"? One might object that laws, being officially enforced standards of behavior, are not as conclusive as a technological fix might be, the very purpose of the latter being to avoid the necessity for controlling or modifying human behavior. One must concede that the imposition of a 50 m.p.h. speed limit is not as effective in keeping all motorists within such limit as would be a uniform engine design limiting maximum speeds to 50 m.p.h. But a "legal fix" can often be an extremely effective means of bringing about desired corrective action. Federal licensing of radio stations was used to eliminate the electronic interference among stations in the early days of radio broadcasting.[63] But the contemporary problem of air pollution with the primary source identified as the automobile internal combustion engine presents an instructive illustration of the significance of context and process and the need for application of a combination of means through time to gain control over a technological abuse.[64] Legal

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62 (continued)
of values comprise the operating system of the technology and must change with new technologies. Such technologies emerge from the political, social, psychological, and economic sciences. They involve organization, decision-making patterns, and values.

63 See Network Broadcasting (1958) Chs. 3, Report to the Committee on Interstate and Foreign Commerce, Jan. 27, 1958, U.S. House of Representatives, 85th Cong., 2nd Sess., January 27, 1958.

64 The range of legal, fiscal, and technological means which are needed in order to substantially reduce air pollution from automobile exhausts are suggested, though not extensively treated, in the following two articles

standards have now set a technological (R&D) target date for drastic reduction in exhaust pollution by 1975.[65] A tax on leaded gasoline has been advanced as a means of inducing gasoline producers to shift to other means of increasing octane rating.[66] While little has been done or proposed to date by way of restricting the use of private automobiles, the public is being conditioned to this possibility.[67] It might be inferred from this action that technological innovations do not just happen; they often need to be planned as part of the strategy for a combined attack

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64 (continued)
from the Bulletin of the Atomic Scientists, November 1970: Bruce M. Russett, "Licensing: For Cars and Babies," p. 15; Murray L. Weidenbaum, "How To Buy A Cleaner Environment," p. 19.

65 See Amendments to the Clean Air Act, December 31, 1970, Public Law 91-604, 91st Congress.

66 See "Welcome Tax on Smog," The Wash. Post, Editorial, Sept. 12, 1970, p. A 18, col. 1; see also William Steff, "Gas Tax 'Essential' to Smog Fight," Wash. Daily News, Sept. 18, 1970, p. 14, col. 1.

> The Administration's proposed tax on lead added to gasoline -- about 2.3 cents a gallon -- is a crucial test of the American people's will to curb air pollution, Treasury Under-secretary Charles E. Walker maintains.
>
> The tax, he told a news conference yesterday, is a "first essential step to cleaning up the atmosphere."
>
> The Treasury and OST experts agreed the critical point about the tax was that it offered "the only way" the auto industry could meet new air pollution standards for its 1975 models.

67 The possibility that legal action will be required to limit the use of automobiles in the largest cities by 1975 has been suggested by Dr. John T. Middleton, Director of the Air Pollution Control Office of the Environmental Protection Agency. See Washington Star, January 30, 1971, p. A 1, col. 4.

on a social objective and as a part of a socio-political process through time. Similarly, there is no "technological fix" at the present time for jet aircraft noise. Such a technological solution appears to be many years off.[68] But a combination of techniques articulated in an overall approach to the problem could do much to alleviate this environmental intrusion. These means would include: accelerated R&D on alternative "quiet engine" technologies, design of new airports based on noise contours with zoning adjusted to acceptable noise levels for various activities, and modified flight patterns and runway locations for existing airports.[69]

What can then be said, even on a tentative basis, of the promise and utility of the notion of the "technological fix." Surely there is much to be said for the resolution of social problems by means which do not require severe restraints on human behavior or which avoid possibilities for mis-management or irresponsible use. What then are the

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68 See "The SSTs May Not Be as Noisy as They Sound," The Wash. Post, Nov. 15, 1970, p. B 6, col. 3. This article by Claire Sterling raises implicitly the interesting question of the most appropriate time and "state-of-the-art" for the introduction of a technological application in order for it to meet with official and public approval.

69 It is clear that the one-factor "legal-political fix" threatened by New York City Mayor Lindsay will not suffice to resolve the total Supersonic Transport controversy. See David S. Broder in The Wash. Post, Oct. 6, 1970, p. A 21, col. 6, "N. Y. Resists SST Squeeze," quoting Mayor Lindsay: "As Mayor of the City of New York, I am prepared to do all in my power to prevent any SST from landing at New York's airports until it is proven safe both to our environment and to the health of our citizens." Some of the great variety of variables involved in the siting of airports are noted in "Boston Debates Airport Growth," N. Y. Times, Nov. 15, 1970, p. 84, col. 6.

characteristics of problem contexts which are susceptible to technological remedies? The concept of the "technological fix" and its application to social problem areas has been discussed with a high degree of understanding of its potential and limitations by Dr. Alvin Weinberg, Director of the Oak Ridge National Laboratory. Dr. Weinberg states: "I do not wish to overstress the role of the physical sciences in this new, social-problem-oriented world. The technological fix is certainly not a panacea."[70] But he goes on to say that "If one accepts the technological fix as one means of alleviating social problems, then surely our reorientation toward social problems ought not to diminish our interest in certain technologies and their supporting sciences."[71] Several examples of existing or prospective technological fixes are discussed by Dr. Weinberg as illustrated by the following extract:

> Today's social problems -- like population, poverty, pollution, and peace -- possess important technological components. How can we look at world population without at the same time examining the development of the remarkable new high-yielding strains of corn, wheat, and rice? How can one consider ways of stabilizing the world order, of achieving peace, without including possible developments in spy satellites and ABM's?[72]
>
> I have gone further and urged that in more cases than our traditional social thinkers are prepared to concede there may be "technological fixes" that could circumvent a seemingly impossible social problem, or at least to so alter its dimensions as to allow new social approaches. Let me illustrate with one "technological fix" -- the Gangetic plain project of Perry Stout of the University of California at Davis (8).

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[70] Alvin M. Weinberg, "In Defense of Science," Science, Jan. 9, 1970, p. 141, 144.

[71] Ibid.

[72] Idem at 143.

> As all of us know, feeding the growing masses of India had, up until 3 years ago, been considered to be totally impossible.[73]
>
> The missing element in Stout's plan is energy, energy to pump water and energy to manufactura nitrogenous fertilizer.[74]
>
> Here is a technological fix: a technologically based scheme, involving new discoveries in agricultural science and in nuclear energy, that could buy significant time in the face of an urgent social problem. This is not to say that this technological fix gets at the "heart" of India's social problem which is over-population. On the other hand, it seems to me to be a much more humane and practical approach than the one advocated by some social planners: to force India to control its population even if this means incredible famine. We technologists are not infallible, and Stout's scheme may not work; but neither are the social planners, such as the Paddocks, who only a few years ago were willing to write India off.[75]
>
> One can easily think of many other "technological fixes" -- such as large tankers as a means of defusing the political sensitivity of the Suez Canal, or the intrauterine device as a means of reducing the social motivation required to achieve birth control. In every instance the fix achieves remedies rather than rooting out causes; and on this account this line of thought has been attacked as being insufficient or inhumane. Yet social problems are never really solved permanently -- one only exchanges one social problem for another, hopefully less pressing, social problem . . . Any resolution of a social problem basically buys time: I see nothing wrong with using technology to buy time.[76]

If then, through technological means we should apply our efforts toward "reforming the environment and stop trying to reform people"[77] what are the identifying characteristics of suitable social problem contexts for a technological fix? One method of approaching this task is to examine the

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73 *Ibid.*

74 *Ibid.*

75 *Ibid.*

76 *Idem* at 143-144.

77 Harold Taylor, "Inside Buckminster Fuller's Universe," *Saturday Review*, May 2, 1970, pp. 56, 57.

interplay between two variables: technological innovation and the political process. Thus, Sayre and Smith in Government, Technology and Social Problems state:

> It would advance our understanding if we could begin to identify a spectrum of social problems ranging from those that are ready for a technological "quick fix" (i.e., politically amenable and within the state-of-the art technically) all the way to those problems that are intransigent in both political and technological terms.[78]

They employ as a "first approximation" of such a spectrum a two-dimensional matrix for identifying social problem areas which are politically ready or unready and technologically ready or unready.[79]

The authors provide many useful insights into the conditions which tend to make a technological innovation (primarily a "quick fix") acceptable to the political process. Among the factors noted are the readiness and attractiveness of the technology itself, the stimulation of "crisis" events, the manner in which the "problem" is perceived and formulated, the effect of pre-conditioning of the political decision makers through "education," the nature of the social interests involved and the extent to which such interests are supported by institutionalized processes, the focus and character of the decisional process involved, the role of "leadership," and the "timing" of the introduction of the proposal into the decisional arena.

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78 Wallace S. Sayre and Bruce L. R. Smith, Government Technology and Social Problems, Columbia University: The Institute for the Study of Science in Human Affairs, Occasional Paper, 1969, p. 12.

79 Ibid.

There are many dimensions to the task of identifying the contextual conditions which may be favorable or unfavorable to the approval of a technological fix as a social problem solution. Where a problem is the result of a single cause, the desired solution is clear, a consensus exists on the need for a solution, and an apparently effective technological means is available, conditions would seem highly favorable for such a solution.[80] Perhaps the introduction of polio vaccine is a classic illustration of a fix applied to such a situation although there was considerable controversy over the mode of distribution.[81] Ordinarily the situation is not so simple. Social problems will not be perceived and defined by all potentially affected participants in the same manner.

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[80] These conditions would be generally applicable to any type of one-factor "fix" whether technological, economic, or legal. Requiring exact change for bus fares (or provision for scrip only as change) to relieve bus drivers of the need to carry cash has proven to be a relatively effective "economic fix" for the problem of bus holdups. And with respect to the potential danger of cancer the "Delaney Amendment" und.rtakes to provide a "legal fix" by prohibiting the marketing of all cancer-producing food additives (cyclamates, for example), the provision stating that no food additive shall be deemed safe if it induces cancer, when ingested, in any animal.

On the latter point see, Alan Kaplan and Robert H. Becker, <u>The Process of Technology Assessment in the Food and Drug Administration</u>. Paper presented at Professional Seminar Series on the Processes of Technology Assessment, The George Washington University: Program of Policy Studies in Science & Technology, #7, Mar. 5, 1970.

[81] See "Chapter Twelve - Congressional Response to the Salk Vaccine for Immunization against Poliomyelitis," in <u>Technical Information for Congress</u>, Report to the Subcommittee on Science, Research, and Development of the Committee on Science and Astronautics, U. S. House of Representatives, 91st Cong., 1st Sess., Apr. 25, 1969, p. 309, by the Legislative Reference Service, Library of Congress: Science Policy Research Division.

Depending upon the problem definition, the resultant context of affected participants, institutions, processes, and social interests will shift. Even where there may exist a broad consensus on a general goal, there may be sharp differences in the precise objective to be achieved, as for example, with air pollution control standards.[82]

Dean Schooler in his article on "Political Arenas, Life Styles, and the Impact of Technologies on Policy Making" analyzes the likely acceptability of technological solutions (physical and behavioral) to social problems in terms of how affected individuals or groups perceive the "impacts" of the application, i.e., whether such impacts will be _redistributive_, _regulative_, _self-regulative_, or _distributive_.[83]

> Thus, a policy building upon or employing a particular technology may _readjust_ wealth, status, or power among major groups; _require_ or _prohibit_ certain activities; _allocate_ desired values to individuals or groups; or _enhance_ or _allow_ individuals or groups to shape their life styles or public policies affecting them.[84]

Schooler suggests that physical technologies are normally seen as distributive and generally beneficial since they are "means of solving social problems without a commitment of time or personality."[85] On the other hand, behavioral technologies evoke the "specter of redistribution or regulation" and are "likely to engender conflict and opposition,"[86]

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82 David Bird, "Two Court Cases on Pollution Illustrate Sharp Differences Over How Clean the Air Should Be" _N. Y. Times_, Mar. 29, 1970, p. 57, col. 2.

83 See note 62 _supra_, at 277.

84 _Ibid_.

85 _Idem_ at 278.

86 _Idem_ at 279.

especially when behavioral technologies involve "structural" changes including the "basic rules" which determine the outcome of policy making.

> Technologies affecting such structure would include hiring practices, reapportionment, cooperative ownership schemes, systems analysis, social indicators and social reports, cost-effectiveness techniques, and other tools or processes of decision making.
>
> These conflicts over structural issues (metapolicymaking) are much more sensitive than conflicts over substantive issues (policymaking)
>
> Like reapportionment, efforts in the "policy sciences" may be perceived as threatening established procedures for policymaking and reallocating the distribution of power and respect within a policymaking system.[87]

However, our concern here is not so much with the acceptability of a given means of solving a social problem, whether such means be a physical or behavioral technological application, as it is with the notion that a one-factor fix of whatever nature can supply a satisfactory solution to an existing social dislocation or provide the means of achieving a basic community goal. Professor Schooler does not elaborate on this specific question. While he does not dismiss the value of the "technological fix" as a means of dealing with human problems,[88] he strongly supports an

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[87] Idem at 280.

[88] Schooler states at 283, note 62 supra:

Physically technology can be used creatively to solve social problems. Amitai Etzioni has argued for physical technology as a "shortcut" to social change (24). He contends that the "ideal" solutions to human problems require prohibitive sums of money or commitments. Furthermore, no evidence has been cited to show that "quick technological fixes" are

analytical concept which seems quite similar to the contextual approach treated herein.[89]

Problem perception and definition which circumscribe the social problem context (or system) to be examined, have infinite variations. Presumably the birth control "pill" should provide the technological fix for population control -- assuming its safety and efficacy. But it is not such a "fix" (at least not at this point in time) for some fairly obvious reasons. Deficiencies of purported technological fixes can usually be disclosed by asking a series of questions setting forth the social context: What technological means, designed for what specific purpose, to be utilized and managed by what participants, affecting what institutions, practices and social values in what manner and to what extent,

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88 (continued)
failures. Perhaps, says Etzioni, street lights and policemen on buses do indeed reduce total crime rather than shift it to dark streets and subways.

One might at least ask, however, that some explication be given to the concept of social problem conceptualization before being expected to systematically discuss the assertion that "no evidence has been cited to show that 'quick technological fixes' are failures."

89 Schooler states at 283, note 62 <u>supra</u>:

> <u>Increasingly, the most useful policy-oriented research will emerge from a multidisciplinary base</u>. If the physical technologists have a contribution to the solution of social problems, then sociology, psychology, political science, and economics must join them in a cooperative effort. Properly designed physical technologies will require evaluation of people's response to the technology, diagnosis of people's present behavior without the technology, and accurate statements detailing exactly what variables the technology must affect. Solutions must be multidisciplinary in their construction.

is proposed? Certainly all participants will not view the problem in the same perspective. From some institutional viewpoints, no population problem exists. Some participants may view population increase as a problem but one that little or nothing can be done about whether the difficulty arises from lack of availability of the means for economic reasons or otherwise, or for reason of institutional constraints, or by virtue of personal value preferences. Effective population control will involve a combination of means, some short term, others long term. The selection of means will be one of proportion among means, not one of exclusiveness of means.[90] Put another way, the more enmeshed the problem in the social process (the greater the number of influential community groups with a diversity of perspectives on the matter) the less likely that a one-factor "fix" will provide an adequate solution. It has taken much more than a simple legal declaration rejecting the "separate but equal" doctrine to make significant headway in achieving racial equality.[91]

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[90] William P. Bundy, "The Tortuous Road to Population Control," The Wash. Post, Aug. 9, 1970, p. B2, col. 1.

[91] James T. Wooten, "Confusion But Still Progress in South's Schools," N. Y. Times, Sept. 20, 1970, p. 10 E, col. 1:

> Thus, the struggle, the bewilderment and the confusion continue. It is a matter of figures, yes; but more, it has now become a battle of strategems, and caught in the conflict are the children and the public education systems of the South.
>
> Nearly a century ago, George Washington Cable, a white southerner of progressive persuasions, wrote that man would walk on the moon before America solves her racial problems. That one-half of his prediction should now be fact is no reason to believe that the remaining portion soon shall be.

Another aspect of the technological fix to which useful attention might be given relates to the decision process leading from the <u>prescriptive phase</u> of formal approval to the <u>application phase</u> of actual use. Put otherwise, what are the characteristics of the formal-authoritative decisional process which are involved in the approval or rejection of the technological fix as a means for social problem solution? Does the approval to use the

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91 (continued)

Of more interest with respect to the deficiences of a hard and fast "legal fix" to complex social problems is the reported question of Justice Black of the Supreme Court in a recent "school desegregation busing" case:

> At what point would busing to achieve exact racial balance be required?
>
> More questions were asked about that than were answered in three days of Supreme Court hearings last week. No ingenious solutions to the dilemma of de facto segregation were offered; indeed no one seemed anxious to fully examine the subject. There was perplexity in Justice Black's question to a civil rights lawyer, "How can you rearrange the whole country?" Discrimination because of race should be corrected, he said, but "it disturbs me to try and challenge the whole living arrangements and way of life of people all over the nation. You're challenging the place people live."

<u>Wash. Evening Star</u>, Oct. 19, 1970, p. A 9, col. 1.

Similarly, the "legal fix" represented by the "Newspaper Preservation Act" is only one of multiple factors which may contribute to diversification of news and opinion in the nation (planned effect).

Declaration of Policy: Sec. 2 of the <u>Newspaper Preservation Act</u>, Public Law 91-353, 84 Stat. 466, July 24, 1970:

> "In the public interest of maintaining a newspaper press editorially and reportorially independent and competitive in all parts of the United States, it is hereby declared to be the public policy of the United States to preserve the publication of newspapers in any city, community, or metropolitan area where a joint operating arrangement has been heretofore entered into because of economic distress or is hereafter effected in accordance with the provisions of this Act."

technological means encompass formally or practically the follow-on decision to actually apply this means? Or can the decision-approval phase be clearly distinguished from the application phase in that an entirely different group of decision makers is involved? These types of questions not only relate to the application of the technological fix but extend to the appraisal phase in that they suggest evaluations of the effectiveness of the approved means.

The decisional process patterns relevant to the initial evaluation, promotion, decision-approval, and application, of a technological fix to a social problem will vary widely. Reference to the System of Technological Assessment/Application will sustain this observation. One need think merely of the combinations of social problem areas, technologies, participants, assessment forums, and decisional arenas to appreciate the variety of contexts which may be involved. For example, if the objective is to recapture national prestige by establishing technological superiority as with the Apollo program; if the focus of decision is with a small group of decision makers at the highest level of authority; if the decision of approval is inclusive of the application; and if the technology is available and other resource support can be assumed, then implementation of the technological fix can be moved along rapidly.[92]

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[92] John M. Logsdon, The Apollo Decision and Its Lessons for Policy-Makers, The George Washington University: Program of Policy Studies in Science and Technology, Occasional Paper No. 7, January 1970.

A second and much broader contextual pattern applies to public service projects such as the construction and operation of new highways, subways, airports, and power plants. Normally, the required procedures provide for a sequence of decisions by a multiplicity of public and private sector participants, including hearings for those segments of the public which will be beneficially or adversely affected by these projects. Hence, the decision, for example, to issue or reject the application for a construction permit for the construction of a nuclear power plant may involve a contentious and drawn-out struggle among competing interest groups. But once the final decision of approval is made, the construction and operation of the plant is assumed as is the consumption of the energy produced.[93]

A third general category of decisional contexts are those in which the decision approving use is distinct from the decision or decisions to actually apply the technological means. The Food and Drug Administration has approved the use of the "pill" but actual application is finally determined by individual or family decisions and the aggregate of such decisions is the measure of the application -- or effectiveness.

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[93] As the demand for more electrical energy increases and the accompanying concern for environmental quality intensifies, controversy can be expected to continue even beyond the construction permit stages especially with respect to nuclear power plants. See "Maryland A-Plant: Boon or a Menace?" with reference to the Calvert Cliffs nuclear plant. The Washington Post, Aug. 26, 1970, p. 1, col. 1. See further comments in Washington Evening Star, Editorial, January 1, 1971, p. A 4, col. 1, "Calvert Cliffs Decision," and the New York Times, January 24, 1971, p. 42, col. 2, "Maryland Atom Plant Gets a Permit."

Here, individual human beings are involved in volitional choices. The one-factor fix cannot be assumed with the same finality as in the first two decisional patterns above if the objective of the use of the "pill" is considered to be overall population control. Highly charged social interest conflicts emerge in this context which question our value priorities, especially the current demands for a "quality environment." Are we really more concerned with the goal of an optimum social environment than with the "natural" or "constitutional right" of the husband and wife to determine family size, even with the prospect of eventual intolerable human congestion? If the latter situation does evolve, then the issue will be whether to impose authoritative controls over family size (to modify or control human behavior). In this instance legal sanctions would be essential to the application of the technological means. Required use of seat belts is also an example of the legal imposition of a technological means to reduce automobile fatalities and injuries.[94] The continuing flouridation controversy represents a somewhat more complicated context involving the decision of approval and the decision to apply dichotomy since, like the "pill," it raises issues of community imposed control versus individual volition.[95] It is a context

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[94] Similarly, the new requirements for installation of "air bags" for crash protection involve both legal and technological means of implementation. See Washington Post, March 6, 1971, p. 1, col. 4.

[95] See Michael Wollan, "Technology Assessment and the Law," (Section on Fluoridation), 36 Geo. Wash. L. R., 1105, 1125 (1968).

which will present continuing difficulties since alternative technological means may be available for achieving the same objective, one applicable on the community or governmental level and the other available for individual, volitional application. In other types of public/private sector decisional contexts, a consensus fix may be demanded.[96]

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[96] See Aaron Latham, "Hot Tenants Protest Lack of Air Cooling," The Washington Post, Sept. 18, 1970, p. C 1, col. 1.

> The protesters, most of them more than 60 years old, marched yesterday with the aid of canes, crutches and braces. Like more youthful demonstrators might, they carried signs, but they walked slowly because their doctors had warned them not to over-exert.
>
> The marchers, numbering about 50, were protesting the lack of air conditioning in Claridge Towers, 1221 M St., N. W., a public housing high-rise apartment building for the elderly that was considered a national model when it opened three years ago.
>
> Monteria Ivey, the acting director of the National Capital Housing Authority, Washington's public housing agency, attended the demonstration and told the elderly marchers that he hoped their building would be air-cooled by next summer.
>
> He said that regulations of the Department of Housing and Urban Development once forbade air conditioning in public housing but that HUD recently changed its mind: in the future, the elderly will be allowed cooling. Public housing families, however, must continue to live with the heat.
>
> Ivey said that the elderly need air conditioning more than families. The marchers yesterday agreed.
>
> "The ambulance comes much more often in the summer," Roberto Wallace said.
>
> The Claridge, opened with great fanfare in 1967, was the nation's first "turnkey" housing project, meaning that NCHA agreed to buy it immediately on completion from a private contractor. The 10-story building has 343 units.

If a technological fix is left to individual volition for application can it be appropriately termed a "fix?" This type of arrangement will often lead to great disparities in application. If individuals view the "fix" as depriving them of a more cherished social value than that perceived to be gained by the technological means, then it is not likely to be applied.[97] But the thrust of the above comments has been that the extent to which a given means will provide an effective solution to a social end can be evaluated only with respect to the specific social context and effective public decision process involved.

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96 (continued)

Sometimes the "public" insists on the development and application of a "technological fix." See for example, The Washington Post, Editorial, Sept. 24, 1970, A 10, col. 1, concerning the Senate vote of 73 to 0 for a bill requiring a 90% reduction in automobile produced pollution by 1975.

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The requirement for a warning on cigarette packages that smoking may be injurious to one's health is certainly a questionable fix for the substantial reduction of cancer resulting from cigarette smoking.

The approval of methadone as a means of alleviating heroin addiction by no means assures that this method will result in an appreciable net social gain.

For conflicting views on the methadone "fix," see the Washington Daily News, March 6, 1971, p. 5, wherein a study group of the Washington, D. C. methadone programs stated that "it is providing therapy on a scale unmatched elsewhere in the country" while a prosecutor of a nearby Virginia County remarked that methadone is a greater threat than heroin.

V - Some Implications of the Contextual Approach for Social Problem Perception, Definition, and Evaluation of Alternative Solutions

The discussion thus far strongly suggests that an effective technology assessment function could impress significant changes on the effective public decision process by identifying the full range of participants, institutions, processes, and social interests affected in substantial technological undertakings. But in this paper we have been concerned primarily with the implications of technology assessment for our attitude toward the applicability of one-factor fixes as satisfactory means of dealing with existing social problems or for achieving desired social goals.

The Sayre and Smith analysis[98] focuses primarily on the "political" process through which a technological "quick fix" must be "filtered" before it can be applied to a social problem context. Their concern is with the conditions which tend to be favorable or unfavorable to the acceptability of a technological means. Of course, the task of adapting an available technology to a relevant social problem area is a matter of critical importance. However, the "implementation feasibility" element is only one aspect of an adequate technology assessment function. Simply because a technological means seems appropriate, the technology is available, and the political climate is amenable, is not conclusive as to the desirability of the application.[99] In fact, innumerable technological projects implemented

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98 Sayre and Smith, *supra* note 78.

99 Perhaps the SST is a good illustration of a situation wherein technical feasibility and initial, provisional political approval clearly do not satisfy the criterion of considering all prospectively affected interests. As the *Washington Evening Star* has stated editorially, "the first consideration had to be the total impact on the nation and the world." Dec. 4, 1970, p. A 18, col. 1. See also "The SST: What's the Hurry?" *Washington Post*, Editorial, Dec. 3, 1970, p. A 18, col. 1.

in the past with only these considerations in mind have either resulted in unsatisfactory treatment of social problems, increased social conflict, or introduced new detrimental elements into the environment. Technology assessment involves much more than an examination of the political feasibility of approving a technological fix. An adequate assessment can not only identify all of the significant effects which might flow from the introduction of the proposed technological fix, but can also clarify other available options for dealing with the particular problem and the social benefits and costs which can be anticipated from the application of each such alternative. Technology assessment contributes to the decision as to whether a technological fix or some other means <u>should</u> be adopted in terms of serving the totality of social needs or demands, as contrasted with an appraisal of whether the technological fix <u>can</u> be moved through the political process. The probability of implementation of a particular means or alternative means is but one aspect of the technology assessment function.

The foregoing comments concerning the relationship of the contextual approach to technology assessment have served to discourage the application of simplistic remedies to complex situations of social stress and conflict grounded in multiple causes. However, it is neither asserted nor implied that one-factor fixes have no utility in particular situations. But this is precisely the point which needs further examination and elaboration, namely, the identification of adequate means for dealing with "social problems." This in turn requires a conceptual inquiry into how problems should be defined for assessment, planning, and program implementation purposes, as well as an examination of the manner in which problems are

in fact defined in most situations today. The means of dealing with a "problem" are, of course, a function of the way in which the problem is defined. But problem conceptualization is a huge and complicated subject, the scope of which can merely be suggested in this discussion.[100]

As a practical matter the operational initiative for the considerations herein discussed commences with 1) a perceived problem, and 2) one or more provisional means of solving the problem. Our attention has been given to the general notion of one-factor fixes as appropriate means of dealing with complex social problems. The "technological fix" is often an attractive means for getting at the primary planned effect sought,[101] whether it be the alleviation of an adverse social impact or the attainment of a desired social objective. As has been suggested, difficulties arise with changes which may be imposed upon various participants (and associated value-institutional processes) which are not identified and taken into account when the assessment focus is limited to the primary

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[100] See Mayo, Louis H., The Problem-Oriented Approach to Legal-Policy-Institutional Innovation (Internal Reference Document of the Program of Policy Studies, The George Washington University, November 1970).

[101] The "skyscraper" may be considered a "fix" which satisfies the need (planned effect) for huge groupings of offices required of vast business enterprises and also a means of avoiding inordinate land costs, but the implications for such functions as efficiently moving urban populations, assuring a continuing supply of power, and providing for adequate fire protection are substantial. Further, psychological adaptation is a problem for those who do not feel comfortable when the towers sway in a strong wind. See J. A. Engels, "Skyscrapers: No Refuge in Superlatives," Washington Post, November 21, 1970, p. E 1, col. 1.

objective as the only significant effect. Further, technological feasibility and even political, economic, and social acceptability (if the latter is limited to the desire to attain the prime objective) do not necessarily assure an inclusive public interest solution.

An adequate technology assessment methodology will assure that those professionals (or the entity) performing the assessment relate the requisite analytical tasks to the realities of the Effective Public Decision Process. This perception forces the assessing entity to recognize, among other things, that the various participants in some manner affected by the proposed application will propose alternative courses of actions in each of the phases of the policy formulation/program implementation continuum. Put otherwise, an adequate assessment methodology will assure that all of the Effects or Changes which will necessarily, probably, or possibly eventuate (based upon explicit assumptions and models) will be identified from the comprehensive examination of the interactions of participants, policies, institutions, and processes. The significance of this observation is that when the assessing entity undertakes to apply the methodology advanced in Part II, *supra*, it must consider the actions and responses which will occur, or probably, or possibly occur (based upon such parameters as the technological configuration being assessed, the future social environment posited, the goals sought to be implemented, and models of individual or institutional behavior assumed, etc.) during each phase of the Policy Formulation/Program Implementation Process. This process can be represented by an approach to

effect identification by reference to the Initiation, Implementation, and Operational stages or through the following phases if governmental action is substantially involved:

- Perception of the "problem"
- Formulation/definition of the problem and the problem context
- Assembly of relevant information
- Consideration of alternative means, i.e., statutory scheme, organizational arrangement, social action program, etc.
- Evaluation and recommendation/promotion of selected outcome
- Formal prescription of new law or authorization of new program
- Application of new statutory scheme in appropriate decisional contexts or the implementation of the prescribed social action program
- Appraisal of the effects of the application of the statutory scheme or of the operation of the social action program
- Modification or termination of the statutory scheme or the social action program based on continuing monitoring and appraisal

These functions, variously phrased, tend to be sufficient to cover the sequence of phases involved in any governmental decisional context. The decisional phases in technological projects initiated and developed primarily in the private sector will differ somewhat.[102]

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[102] The private sector would be concerned with basic research, development, production, distribution, and market response decisions among others.

The assessment phase must include a provisional judgment and assumptions with respect to all of the succeeding phases. A given technological means might be considered a "fix" to the extent that it maximizes social benefits and minimizes social costs associated with the total Policy Formulation/Program Implementation process. It would seem that facilitating actions of some sort will normally be required in each phase. In short, few fixes -- legal, economic, or technological -- are self-executing.

The essential point here stressed is that effects or changes in various value-institutional processes with respect to certain participants occur or may occur at any or all phases of the Policy Formulation/Program Implementation Process. A thorough contextual assessment must take into account such effects. Limiting an assessment merely to the operational phase may result in ignoring some of the most significant changes which will occur in the establishment of a new program or technological project. For example, should a proposal be made to construct a center-city STOLport to meet urgent demands for more efficient and flexible inter-urban short-haul transportation, it is clear that serious community decisions would be required relating to resource allocations among various goals and that vigorous public controversy might likely result. Assuming approval of such a project, the displacement and relocation of businesses and residences would be only one of several substantial effects during the implementation phase. Such effects as improved mobility or increased aircraft noise would not appear until the operational phase. Instances abound of new technological

projects which require positive action or generate critical reactions in the initiating and implementation phases.[103] Such actions and reactions are effects which convert into beneficial or detrimental social impacts.

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103 It should be evident that the designation of stages of the overall developmental and application process as Initiation, Implementation, and Operational is not meant to imply that such stages are separate and distinct or even fully incorporate all of the decision/action operations involved. Sometimes the stages may be essentially distinguishable, but in perhaps most major projects a variety of developmental sub-processes link and overlap these stages. For example, considerable basic research may necessarily precede the overt Initiation stage. See Washington Post, March 9, 1971, p. A 4, col. 1, re test of the "H-Machine" in the experimental phase of developing nuclear fusion as an energy source. Pre-Initiation activity may also raise serious controversies which can lead to significant decisions with respect to a large pattern of scientific research and technological applications. See Victor Cohn in the Washington Post, January 29, 1971, p. A 1, col. 1, with respect to genetic engineering ("test tube babies"). Further, implementation may be taking place at the same time the authoritative Initiation/Approval decision is being debated or made. Huge investments were made by various oil companies in the North Slope Pool of Alaska long before the current controversy over the formal decision to approve or disapprove the Alaska Oil Pipeline. See "Alaska and Oil: Tough Questions," in the New York Times, February 28, 1971, p. 55, col. 2. While the "national data bank" issue continues to be argued, personal data is being rapidly computerized. See "When We Get All The Data In One Place," New York Times, February 28, 1971, p. E 4, col. 3. Nevertheless, the identification of stages or phases of the overall policy formulation and program implementation process normally provides clarity and precision to analysis.

It should also be recognized that a decision can be made to reverse an Initiation/Approval determination well into the Implementation stage of a project. See "Florida: Nixon Halts Canal Project, Cites Environment," Science, January 29, 1971, p.357. This project also demonstrates the fact that major effects take place in the Initiation stage (investment in rights of way and the construction of barge terminals and other canal facilities) and that Implementation effects include both increased job opportunities and destruction -- to some degree -- of the natural environment.

Hence, even if the means of satisfying a social demand is primarily technological and can be plausibly called a "fix," in most if not all cases the inevitable, probable, or possible effects will involve supporting initiatives in the various value-institutional process areas in order to increase the benefits or minimize the costs or perhaps even to enable the technological means to be applied at all.[104] An adequate technology assessment methodology will disclose such effects and the nature of the active or passive impact which will result. Furthermore, testing out a proposed one-factor fix by applying the contextual assessment methodology may disclose, for example, that:

- The fix selected affects a much wider social sub-system (context of interacting participants and value-institutional processes) than the context initially subsumed under the problem as perceived.

- The fix is not sufficient in itself to solve the problem or advance the social goal -- that it must be supplemented by facilitating techniques at one or more of the phases of the Policy Formulation and Program Implementation Process.

- The assessed implications of the fix suggest problem context redefinition. The assessment outcome may show that the fix can be effectively applied to a more narrowly focused social

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[104] As noted, a "fix" may be considered as a <u>means</u> of solving an existing social problem or of achieving a social goal. But it soon becomes obvious upon examination that if weather modification is selected as a means of increasing the water supply in a given river basin, there are numerous legal, jurisdictional, organizational, and financial arrangements which are essential to the operational efficacy of this means for the simple reason that there are innumerable effects or changes which will result from or which are advisable to take in order to maximize the benefits.

Similarly, the so-called "housing problem," with which Project Breakthrough of the Department of Housing and Urban Development is now concerned, can by no means be solved with the most advanced housing/construction technologies alone. Difficulties here are rooted in traditional legal doctrine, real estate transaction practices, mortgage and investment institutional procedures, housing codes, union practices, industry decisions related to the size of aggregated markets, and so forth.

objective or that the fix, in combination with other techniques, has the potential for effectively achieving the solution to a broader social problem context than that initially posited.

- The fix is applicable only to a short-term solution and other means must be employed for a complete solution or for continuing control of the problem. The analysis may further suggest alternative strategies for securing the objective sought as by the application of various techniques, appropriately introduced into the policy formulation and program implementation process and coordinated through time.

- A fix (whether technological, economic, legal, etc.) is not a satisfactory solution for the problem context posited and that nothing short of a drastic modification of individual or organizational behavior (not provided by a simple fix) will suffice to achieve the desired social objective. Of course, several significant questions are raised by this implication. Should it be assumed, for example, that a technological short-cut which avoids the need for change in human attitudes and social behavioral patterns is always to be preferred?[105] Many observers

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[105] In "Man the Magician: Watch Us," The Wash. Post Book World, Aug. 16, 1970, p. 4, Edward Edelson states:

> Technology has failed us because we let it run wild. Instead of following human logic, we have followed technological logic. If something could be done, we have done it without considering the human consequences. We need a basic change of attitude. The engineers must start thinking about the human uses of technology -- giving the greatest benefit to the greatest number, not creating the biggest machine for its own sake.
>
> The rest of us need an equally basic change of attitude, toward the objects of everyday life. Here is one example of what must be done:
>
> In the past few years, most middle-class Americans have become accustomed to air conditioning, at home and at work, now even in automobiles. Air conditioning is an avid consumer of electric power, and all power pollutes, either by adding to air pollution or by disrupting a wild area or by adding too much heat to water.
>
> The people who protest today about pollution do so in air conditioned comfort. They shave with electric razors and use electric can openers. They buy eight-cylinder cars and insist on power steering. With every gesture, they make more pollution necessary. Then they sign petitions to make the problem go away.

think, to the contrary, that drastic shifts in social attitudes and behavior is the really crucial issue.[106]

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105 (continued)

It is useless to double our consumption of electric power every ten years and demand less pollution. The only real solution is to use less of everything -- really, <u>everything</u>. And that, of course, is an economic disaster.

See also on the same theme, "Environment: The Human Element," Review and Outlook Column, <u>The Wall Street Journal</u>, Sept. 1, 1970, p. 12, col. 1.

> All sorts of environmental problems could be solved if people were more friendly to the idea of paying a bit more to incorporate the cost of protecting the environment into manufacturing processes. In other words, as we have pointed out in these columns before, solutions to the problem of the environment so serious to the cities may lie most basically in effecting changes in individual values and tastes.
>
> That is no easy job, even when serious discomforts and inconvenience grow to critical levels for the whole society. For the moment it seems to present policymakers with a bleak choice. They can let the drift to crisis go until the day when catastrophe creates popular demand for change, perhaps at the price of lost life and massive unhappiness. Or they can try to force the change to avert catastrophe by moving against the will of the people, which in a democracy, after all, must be considered valuable, too.
>
> Perhaps there is some happier third choice which would yet come clear (popular response to gradual limits) on auto use in New York City, for example, has been encouraging. But we doubt if new technologies or their management will play much role in finding better solutions, however well they are managed. For it is the human problem that is the heart of the matter, and the real cause for worry when multiple crises strike a city.

106

See <u>The New York Times</u>, September 20, 1970, p. 13, col. 1, "Maxims Are Cut Down by English Economist (Prof. Edward J. Mishan)":

> "Everything I say goes against people's democratic instincts, 'why shouldn't we choose what we want?' they say. What people want, however, is not wisdom but immediate gratification. They have been taught by the system to be myopic, and when they have power they corrupt themselves. What they need is not power but strength of character and morality. In this they are not well served by the Establishment."

Assuming that some degree of flexibility exists in the consideration of the social objective sought and in the means (resources) to be applied, then

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106 (continued)

Victor Cohn in "Scientists' View of the Future," in The Washington Post, January 4, 1970, p. A 3, col. 6, comments:

> Science then is undergoing a change -- for morality. Will the public?
>
> The specific question, maintained many speakers, is: Will the public pay the bill for survival? Or will it make other, "less moral," choices?
>
> Scientists who said population must level off also said this will require much sacrifice by wealthy nations and families to bring health, social security and higher living standards to poorer nations and families. Only then, it was stated, will the insecure stop producing huge families as their only social security.
>
> "We the prosperous," it was widely agreed, will have to give up big cars, big defense budgets and big man-in-space programs to pay the required economic and social bills.
>
> But Americans, predicted S. Fred Singer, physicist and Deputy Assistant Secretary of the Interior, will refuse to pay even the environmental clean-up bills, when they realize how big they must be. Already, noted Dr. Philip Lee, Americans are refusing to pay the bills "for quality education and adequate health care" of the 25 million people added by the baby boom of 1947-57.

On the population/birth control problem, Colman McCarthy writes in "Ecology and the Bias for Living," The Wash. Post, January 15, 1970, p. A 17, col. 3:

> As arrogant as the industrial and commercial polluters are, they are still only serving a public which demands more cars, planes, textiles, chemicals and comforts for more "civilized" living. In the end, it is man who pollutes. Thus, the pollution problem runs parallel to the population problem: the more people, the more pollution. The day is past when theologians can stand back and argue against birth control on grounds of morality. An over-polluted overpopulation must not only argue for birth control, but must perhaps seek to legally enforce it -- on grounds of survival.
>
> Unless massive birth control is practiced immediately, no amount of public money or private worry can keep the earth from becoming what Buckminister Fuller called, "the planet Polluto." In a grim

the foregoing observations tend to emphasize the provisional nature of the policy analysis (technology assessment) function. There will probably be a continuing interaction and adjustment between alternative concepts of the relevant social context (participants, values and institutions affected) and the alternative configuration of resources (means and techniques) to be employed. This determination of the "best" or of a "satisfactory" arrangement may, of course, differ as between the assessing entity's outcome and that of the ultimate political decision-makers when the program is finally approved.

Therefore, from the foregoing discussion one might reasonably conclude that with respect to almost any social problem of consequence for which a provisional means has been selected, such means should not be adopted for the simplistic reason that it coincides with one's intuitive judgment as to the suitability or applicability of one-factor fixes generally.

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106 (continued)
way, the backlash of nature may well inflict, in the absence of birth control, universal pollution as a form of death-control.

On the significance of the population problem see Claire Sterling, "India: The Nightmare Demographers Warn us About," The Washington Post, Sept. 2, 1970, p. A 22, col. 3, indicating that the population of India has doubled in the past 30 years and may double again in the next 20:

> This is the nightmare demographers have been warning us about, the sudden, terrifying leap in population that comes of staving off death without restraining birth, the inexorable statistic that could make life very nearly unbearable on our planet in our lifetime . . .
>
> For some time now, and especially since 1966, the Indian Government has been trying to control human birth on a scale, and in a style, that has never been tried before. The difficulties are so tremendous that some observers have already written off the campaign as lost. They are mistaken, I think, if only because a campaign like this cannot be decisively won or lost. Every baby that might have been born and isn't puts India that much ahead -- a fraction of a hundred-millionth, perhaps, not much but more than nothing.

Unfortunately, there often exists an irresistible urge to reduce problems to the narrowest possible context and to consider the simplest types of alternative solutions. Such thought processes tend to focus upon only a single or limited pattern of anticipated consequences which are of paramount interest to the particular participant. Emphasis on specific consequences further leads to the selection of means related directly to such consequences. Instances of this type of thinking are frequently exhibited in the public decision process.[107]

The value of the contextual approach to assessment set forth in Part II, supra, is that such an assessment of even the most limited type of means or fix proposed for a social problem solution can disclose not only the deficiencies in such means for the social problem as initially posited but the configuration of means appropriate to its solution or the need to redefine the social context which can

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[107] In the Congressional debate over the proposal to continue work on the development of two prototype SST's (estimated overall cost of $1.3 billion) the Washington Daily News reported on December 1, 1970, p. 9, col. 1, that the Citizens' League against the Sonic Boom argued that the SST would have a "significant impact" on marine life in the Atlantic while

> The principal argument advanced by proponents of the SST is that the Anglo-French Concorde and the Russian TU 144 have already flown at supersonic speed, and thus the question boils down to whether the U. S. airlines will be able to buy a U. S.-built SST or will be compelled to buy one manufactured abroad.

most appropriately be treated at the particular time with the resources available.[108] In short, the contextual approach provides a systematic and reliable method for determining all of the effects and interactions associated with the application of specified means to achieve particular goals within the relevant social problem context.

An adequate technology assessment function should make a significant contribution to the task of clarifying alternative courses of action, most of which, with respect to complex social problems, will combine a mix of technological, economic, political, legal, and social behavioral means. An adequate assessment can greatly assist in the determination of the social benefits and costs which will flow from the adoption of each alternative. Assessment outcomes which do provide such clarification should exert considerable influence in authoritative decisional arenas where decisions are ultimately made for the allocation of resources, the distribution of benefits and costs, and the prescription of legal rights and duties. This evaluation of the ultimate impact of the assessment

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[108] In this connection see the Report of the National Academy of Sciences/National Academy of Engineering, Jamaica Bay and Kennedy Airport: A Multidisciplinary Environmental Study (February 17, 1971) which "considered as many significant factors of urban life as it could" and explicitly rejected the simplistic and misleading definition of the problem of whether to expand the airport by further fill of the bay as one of "Birds versus Planes" or "Jobs versus Pollution." See NAS/NAE News Report for February 1971, which includes a comment on the Jamaica Bay Report.

function on the national policy process assumes, of course, effective implementation of the assessment function.[109] Prospects for effective

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109 This is clearly a questionable assumption as the following comment from Dan Greenberg, New Scientist, Sept. 10, 1970, p. 552, suggests:

> DuBridge's successor, Edward E. David Jr., arrives with sound professional credentials, but the record is blank on whether he possesses the guerilla instincts so indispensable for operating from a narrow power base in Washington. The big agencies, with their massive spending power and allies in Congress, can bulldoze the route to their objectives. The White House science office, on the other hand, must rely on a whispered comment to the Bureau of the Budget, a discreet exploitation of a presidential preference or interest, a judicious bit of testimony harmonizing with what a congressional chairman thought anyway.

The above statement, however, seems to make an assumption concerning the role of the OST which has not yet been resolved, i.e., which entity in the Executive Branch will have the ultimate technology assessment responsibility: the Office of Science and Technology, The Council on Environmental Quality, the Domestic Council, the Office of Management and Budget, etc. In this connection see the recommendations of the Report of the President's Task Force on Science Policy, Science and Technology: Tools for Progress, April 1970 which suggests the OST and the Report of the National Academy of Public Administration, Technology Assessment System for the Executive Branch, to the Committee on Science and Astronautics, U. S. House of Representatives, July 1970, which recommends the Council on Environmental Quality.

Hugh Folk questions whether "additional information will improve policy making in technology and science." He doubts the validity of the underlying premises of technology assessment: "that the government wants to make good technological policy, has the power to make good policy, and would recognize a good policy if one were proposed. The premises are at least questionable, if we interpret 'good' as meaning in the interest of the survival, prosperity, and liberty of the mass of the population. Many powerful politicians . . . have no concern for the national interest at all, but serve the parochial interests that permit their political survival."

"I can only conclude that neither the Administration nor the Congress want a rational system of policy assessment. Politicians are elected at vast expense because they serve powerful interests not all of which are compatible with the public interest."

implementation are briefly considered elsewhere by the author.[110] So long as assessments are performed on an _ad hoc_ and incidental basis, there is little reason to expect that they will contribute a substantial added increment of rational control over the direction and rate of social change. An adequate assessment must be recognized as a crucial element in the planning phase of the proposed introduction of any new application into the social process.[111] Implementation will then require the necessary resources of analytical skills, information networks, and the coordinating mechanisms which can produce a systematic integration of inputs from a variety of assessing entities.[112] The assessment function can then provide effective

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109 (continued)
". . . they (politicians) understand that sound policy assessment might limit their freedom of action and their ability to serve their masters in good conscience and political safety."

Hugh Folk, _The Role of Technology Assessment in Public Policy_ (Paper presented at AAAS Annual Meeting, Boston, Mass., Dec. 29, 1969), pp. 1-3.

110
See statement by the Program Director in the _1969-70 Annual Report_, The George Washington University: Program of Policy Studies in Science and Technology.

111
Walter Sullivan, science reporter for the _New York Times_, wrote recently:

> "In essence the United States has reached the stage where no one element of civilization can be developed on a large scale without critically affecting other elements." Unless techniques of "technological assessment" are brought into play, he says, "the Great Machine of our civilization will increasingly work at cross purposes."

"Environment: The Human Element," Review and Outlook Column, _The Wall Street Journal_, Sept. 1, 1970, p. 12, col. 1.

112
See generally, Gabor Strasser, _Developing a "Technology Assessment" Capability: New Analysis and Planning Methods with a Scope Much Broader than Technology_, Executive Office of the President: Office of Science and Technology, May 1970.

guidance for developing deliberately selected conditions of future social environments.[113]

It is apparent that "ideal solutions," in terms of treating the most relevant problem contexts, are not always feasible for reason of political, budgetary, institutional, technological, or other constraints, including analytical/planning deficiencies. One-factor fixes are frequently the only recourse for dealing with crisis situations. Further, the complexity of the socio-political process, including the vast uncertainties involved in long-range projections, is a compelling reason in the judgment of many decision-makers for adopting cautions, short-term, partial measures rather than comprehensive arrangements for coping with major social problems through time. In many social problem areas we simply do not know enough to assess the situation and develop appropriate means for adequately dealing with the matter as an overall problem. Even so, such means as are selected for application should be fully assessed for planned and derivative effects. Only in this manner can such means be appraised for actual net contribution, if any, to the solution of the problem posed.

It is submitted that the contextual approach to technology assessment (which recognizes the dynamic processes of society such as the Effective Public Decision Process and the Process of Policy Formulation/Program Implementation with respect to given undertakings) will prove more

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[113] Louis H. Mayo, "Comments on H. R. 17046," Technology Assessment -- 1970: Hearings before the Subcommittee on Science, Research, and Development of the Committee on Science and Astronautics, 91st Congress, 2d. Sess., May 20, 21, 26, 27; June 2-3, 1970, p. 210.

productive in the attainment of inclusive public interest goals than precipitous grasping at short-cut, one-factor fixes. While no social benefits are without costs, an adequate technology assessment function can greatly assist the efforts toward policy formulation and program implementation by clarifying optional means or combinations of means which maximize social benefits and minimize social deprivations.

N76-15935

II. DEVELOPMENT OF THE CONCEPT OF TECHNOLOGY ASSESSMENT

D. Technology Assessment: What Should It Be?

Guy BLACK

June 1971, pp. 33-41

D-4

V. CONCLUSION

Technology Assessment in Analytical Context

It is clear that technology assessment--even a preliminary technology assessment--means balancing the desirable against the undesirable. The Council of Economic Advisers to the President says "while it might be tempting to say that no one should be allowed to do any polluting, such a ban would require the cessation of virtually all economic activity."[14] It is characteristic of much of the concern over second-order effects that many proponents look only at adverse consequences of programs without balancing these against the desirable results. Clearly, this balance must be struck in every administrative decision, and to do this requires integrating not only information on second-order consequences, but also the desirable consequences which are the primary purpose of the program.

Technology assessment cannot reasonably be considered to be the whole analytical scope of program analysis. There is, therefore, a need to integrate the results of technology assessment with other program analyses. The essential consideration is that the results of technology assessment be supplied in a form that permits integration with other information.

There is a need for consistency of definitions and classification schemes. It is the usual practice in cost-benefit analysis to discount future costs and returns. Official guidelines prescribe the discounting rates. Cross-the-board consistency in program analysis depends on

uniformity of the rates so that if technology assessments use discounting, it should use the rates currently in use for related program analyses. In aerospace-type systems analysis, establishing the compatibility of analyses is one of the functions of systems engineering--a coordinating role.

Some part of the notorious difficulty of successful interdisciplinary research results from the incompatibility of data outputs from various disciplines, as they are normally produced. Only in a few instances and for some disciplines have successful bridges been built. For example, certain elements of the behavioral sciences are now fairly well integrated into the work of some economists, though others resist the integration bitterly. In a classic article, Hollis Chenery showed how the results of an engineering analysis, expressed in the format traditional to engineers, could be transformed into the format useful to economists.[15] Dorothy Rice has, in a well-known study, transformed life expectancy data into a form useful in economics and cost benefit analysis.[16] Technology assessment must be interdisciplinary, and the integratability of analysis is crucial. Interdisciplinariness in research does not mean merely a willingness to listen and respect each other. The results of analyses tend to be data, and an interdisciplinary analysis must meld--and not merely report on alternate pages--results from a number of disciplines.

Can Technology Assessment Produce Results?

For technology assessment to be worthwhile, the decisions and follow-on actions of governments and other organizations must somehow be different

than they would have been otherwise. It is instructive to examine the impact of planning studies, which are markedly akin to technology assessment--indeed, it is possible to consider that technology assessment amounts to a broadening of the focus of planning.

The frequency with which planning studies have been ignored by decision makers is notorious. Although the quality and content of the studies is sometimes at fault, it would appear that the most common difficulties lie in the relationship between the planning body and the decision makers. Planners often fail to include plans for implementation. Indeed, planners who perceive their role as technicians severely limit their willingness to deal with and make explicit recommendations for implementation.

These same considerations are bound to affect the degree to which technology assessments affect public decision processes, although it is presently difficult to see the technology assessment specialist as a policy-neutral technician. While some--and perhaps considerable--lack of consideration and utilization of technology assessment must be expected, every effort should be made to minimize it, if only to increase through utilization the efficiency of the analytical effort of technology assessment. Efficient use of analytical resources is certainly a worthy objective; everyone would agree that it can be enhanced by the efficient organization and implementation of studies, but unless final reports are to be the end products, applying the criteria of report quality to a planning effort is a suboptimization; a more meaningful criteria is obtained by comparing benefits to society that flow from decisions with

the study and without it. In these terms, a mediocre study by professional criteria may actually be superior to glittering gems of analysis, undecipherable to nonprofessionals.

As to the means by which technology assessment can be efficient in these terms, there is room for considerable speculation. I would advance a few propositions:

- technology assessment will have more impact when the analysis is competent.
- it will have more impact when it conforms to the values and philosophies of decision makers.
- it will have more impact if its results are communicated to decision makers before they become committed to specific programs.
- it will be more acceptable when it is relevant to the high-priority decisions which are the immediate responsibility of the decision makers.
- it will have more impact if it does not threaten the power or prestige of the decision makers.
- it will have more impact if it presents alternatives rather than calling for or demanding one rigid course of action.

The last point is particularly debatable, since it runs counter to a highly popular strategy--namely the presentation of a single program as the only possible course of action, around which all available support can be marshalled; presenting alternatives may dissipate support for any action at all, and indeed is a common tactic of opponents

of any action. But the function of technology assessment is not advocacy, but to give decision makers a larger and better hand from which they can select their trump cards.

Implementation in the public sector as a political process is often left out of planning. The implementers, as elected officials, are oriented toward widely varied emphases, systems of values, and reflect different balances of community interests. In a typical public decision-making body a large number of points of view are involved, and the resulting decisons are typically a compromise. There is, therefore, rarely a single cohesive set of value judgments, preferences and community interests which can serve as a starting point for the planning process.

Technology assessment is an exercise in value judgment as well as in the development of hard factual information. Second-order consequences may be the hard information part, although the fact that a program will rouse opposition because it runs counter to the value judgments of some part of the community is hardly irrelevant in the planning of mission-oriented agencies.

It is on this point that the mission-oriented governmental agency is confronted with one of the dilemmas of the American political process. There is still considerable adherence to the doctrine that value judgments are the prerogative of Congress and that the bureaucracy implements programs consistent with those judgments. Agencies hesitate to establish identifiable, wholly effective capabilities for selecting and implementing their own value judgments.

If analysis had nothing to contribute to the formulation and implementation of value judgment, this would not be serious--but it has. Persons in agencies concerned with value judgments rarely have much analytical support for this part of their function. The process is an under-wraps activity of top administrators and political appointees whose status gives them a special basis for the exercise of value judgments. Perhaps their most available forums are coequals from other agencies, although performance may be seriously handicapped by interagency rivalries.

The points made above suggest that no single technology assessment is likely to be satisfactory to the entire structure of decision makers. Public decision making is structured; within the executive branch there is a hierarchy of task and mission-oriented agencies which differ in their prescribed area of activity. Offices lower in the hierarchy generally have restricted areas of operation and mission. The principal thrust of their effort must inevitably be on carrying forward the program which is their principal assigned responsibility. Performance will be judged in those terms.

In short, technology assessment directed to mission-oriented agencies must be restricted to the scope of agency interest and responsibility; otherwise it loses relevance to that agency. But, from a public point of view, assessment in these terms is too narrow. A management-oriented approach to analysis means also limiting the depth of analysis to the point where reasonable bases for management decisions have been provided. Analysis on this basis often lacks completeness and elegance. Some part of these faults can be remedied through technology assessments

produced for elements of government with multi-agency points of view. At the apex, within the executive branch, and the client for truly broad technology assessments, is the President and the executive office.

Taken as an entity, the Congress might be considered to be the client for broadly oriented technology assessment, and the general public for even broader efforts. But to view the Congress and the public as entities is surely an error. The principal work of the Congress is in committees, and the client in Congress for technology assessments is not primarily the Congress as a whole, but various committees. As their functional areas are limited so are the scope of the technology assessments which will appear to them to be relevant. There are, to be sure, Congressional committees which habitually take broad points of view and for whom broadly oriented technology assessments will appear to be relevant. Much the same problem would appear to exist with respect to the public. Nonetheless, given our political processes, the public audience for technology assessment cannot be neglected if technology assessment is to fulfill its promise; and the means by which the public can be reached are as yet unresolved.

The relationship between the programs and actions of governmental agencies and the milieu in which government acts will ultimately have much to do with the contribution made by technology assessment. Relationships between the character of government programs and second-order effects are often subtle. For example, prohibition of liquor, narcotics or cigarettes tend to create black markets, to support a criminal

element which in turn corrupts others. These effects are, quite appropriately considered second-order effects of any kind of prohibition.

An additional determinant is the degree to which the social needs to which programs and sought-for first order effects are satisfied. So long as the need is desperate and pressing, it will be difficult to convince many that second-order effects need to be taken seriously.

In Summary

In summary, it is a mere platitude to note that society is ever changing its techniques, and that the effect of the changes are far-reaching. What is new is the effort to predict the whole structure of change, to evaluate it, and to identify the best of the apparently-available alternatives. It is perhaps too early to say that there is new emphasis on implementing the results of such assessments of technology, though clearly there is a new determination to preserve what is best in our environment.

As yet, this determination has been poorly focused, short on analytical support, and uncertain as to how to make the tradeoffs among desirable alternatives. In the emphasis on evaluating the consequences of scientific research the proponents of technology assessment may very well have made a sound strategic decision, but the impact of change from other causes is often equally important and so inextricably bound up with science that it is not really useful to restrict technology assessment to the products of science.

Potentially one of the more serious shortcomings of technology assessment may be an unawareness of important second-order relationships.

It would seem that a far-reaching preliminary search for possible relationships should proceed analysis in depth. Following this, the main thrust of analysis must be problem oriented, must avoid being discipline-bound, and must be comparable in structure to systems analysis. System models, the framework of such analyses, typically are simplifications achieved by explicitly setting aside second-order effects, and because these are the heart of technology assessment, a different modelling approach is called for.

Technology assessment must not attempt impossible precision. The structure of the future consequences is largely stochastic, meaning that an array of possible outcomes, appended by probability estimates, should be the sought-for result. Forecasts and predictions developed in this way lend themselves readily to the methods of decision theory which may well become a basic element of technology assessment.

The means by which technology assessment can be integrated into decision making are still unresolved, and crucial. Let us hope that there will be no repetition of the experience of planning, in which the results of analysis have so often been ignored.

FOOTNOTES

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II. DEVELOPMENT OF THE CONCEPT OF TECHNOLOGY ASSESSMENT

E. Social Impact Evaluation: Some Implications of the Specific Decisional Context Approach for Anticipatory Project Assessment (APA)

Louis H. MAYO

November 1972, pp. 1-18

D5
PART E

I. CONTROL OVER SOCIAL CHANGE THROUGH ANTICIPATORY PROJECT ASSESSMENT

It seems a plausible assumption that man has always, to a greater or lesser degree, undertaken to grasp and maintain some control over his environment through anticipatory assessments of proposed actions. Two basic questions are involved: 1) What changes in the social environment will be brought about by the contemplated action which would not otherwise occur? and 2) What will be the social significance of such changes?

While the effort to impose some measure of control over the direction and rate of social change has a long history, the prospective evaluative function has come to unusual prominence in the past decade in large measure as a result of the perception of incompatibility between uncritical expansion of industrial-consumption practices and the new urgency for access to and enjoyment of a much broader spectrum of social values. The resulting need for more careful allocation and application of available resources to pressing, and competing, social needs is evident. This being so, we are understandably becoming more concerned with the inability of influential decision-making entities to identify and evaluate the full range of consequences which will or may flow from new public or public/private initiatives - technological or otherwise.

Anticipatory Project Assessment, whether expressed as policy analysis, social impact evaluation, or technology assessment, can be characterized as the capacity to perform, and the disposition to take into account in relevant decisional arenas, the following operations:

- Identification of the significant effects (necessary or inevitable, probable, or possible) which will result from the introduction of a specified project configuration into alternative projected future social environments during the planning, implementation and operational stages.

- Evaluation of such Effects in terms of Social Impacts on affected participants and social value-institutional processes in accord with specified concepts/standards of Social Justice, i.e., schemes of social value weight and distribution.

Presumably, from the perspective of the accountable, public sector decision maker, this evaluative function will contribute an appreciable increment of control over the direction and rate of social change by: 1) facilitating judgments as to when or when not to take particular innovative actions; 2) providing insights into the advisability of taking major, all-out efforts as contrasted with incremental response to changing conditions; and by 3) suggesting the more preferable project configurations (alternative means) to apply to the achievement of objectives consistent with intended (or acceptable) concepts of Social Justice.

II. THE NATIONAL ENVIRONMENTAL POLICY ACT OF 1969: A FRAMEWORK FOR EXAMINING THE ANTICIPATORY PROJECT ASSESSMENT FUNCTION

The National Environmental Policy Act of 1969 (NEPA 1969) provides a useful framework for evaluating the prospective development of the Anticipatory Project Assessment Function in that the conditions and trends previously noted will have considerable effect on its implementation. This Act would seem to have substantial utility as an instrument for moderating the direction and rate of technological innovation as a component of social change. It also has considerable potential for advancing the public policy analytical capability of the nation. First, however, we should consider the possibility that the §102(2)(C) "environmental impact statement" requirement for all major Federal actions could be a delusion to the extent it becomes form rather than substance. But assuming that this requirement can be a tremendously potent instrument for anticipatory project assessment, one must look closely at the prospects for the development of this potential. Environmental impact statements have been required since January 1, 1970, it is to be noted, but without benefit of the organizational resources and conceptual and analytical skills which NEPA explicitly recognizes to be necessary. §102(2)(A) directs agencies to:

> utilize a systematic, interdisciplinary approach which will insure the integrated use of the natural and social sciences and the environmental design arts in planning and in decision-making which may have an impact on man's environment;

and §102(2)(B) directs that agencies develop methods, procedures, and techniques

> . . . which will insure that presently unquantified environmental amenities and values may be given appropriate consideration in decision-making along with economic and technical considerations; . . .

The establishment of an assessment requirement by NEPA has some initial value as a means of focusing attention on the assessment function and in creating a "market" for a needed capability as well as project evaluation outcomes. However, it remains a fair and critical question as to how we can reasonably expect adequate anticipatory assessment outcomes in form of §102(2)(C) statements when the resources made available for developing the requisite analytical capability remain at a precariously low level. Perhaps only catastrophes, persistent court actions to implement legislation requiring impact statements, and angry citizen protests of particular projects (with resulting delay and increased costs) will eventually stimulate the necessary support for an adequate anticipatory project assessment function.

For present purposes, however, let us assume that resources will be made available for APA and examine some of the questions which will arise in the analytical operations of an assessment function. Attention will be directed to the implications of §102(2)(B) since this subsection refers to the analytical component of the assessment process. The injunction that Federal agencies develop techniques which will "insure that presently

unquantified environmental amenities and values . . . be given appropriate consideration," presumably in a rational process of decision, obviously obscures and ignores a great deal more than it illuminates. For example, §102(2)(B) refers to "environmental amenities and values" which must mean that certain "values" should be given explicit recognition and some measurable degree of social significance in the public decision process. If so, then §102(2)(B) refers to only the final step in a rather intricate methodology of anticipatory assessment. §102(2)(B) suggests no distinction between the effects (changes or consequences) which might flow from the introduction of a technological application into a future social environment, the widely varying types of effects, the participants and social interests which might be affected by each change, and the social impact to be attached to each of these changes on participants and value-institutional processes. Further, the task of giving some measurable or operational significance to affected social interests will vary with the characteristics of the Decisional Context.

Put otherwise, §102(2)(B) is without discrimination as to Decisional Context, stating only that techniques be developed so that "presently unquantified environmental amenities and values may be given appropriate <u>consideration</u> in decision making." (Italics supplied) The same <u>effect</u>, as for example noise from transportation systems, will clearly differ with the decisional situation. Noise can be measured or quantified in physical

terms on a decibel scale and by various facilitating constructs such as NEF and CNEL. Further measurable dimensions can be given to noise effects by such means as determining the number of people residing within a given NEF contour. While this is a means of measuring the magnitude of the noise effect it is not an evaluation of the social significance of the noise or conversely, the degree of social interest in noise abatement. The social significance will depend upon a number of factors such as competing social interests involved in the particular decision context. One might plausibly take the position that no social value can be "quantified" in terms of operational social significance without relating it to a specific decisional situation.

Presumably, the underlying rationale of §102(2)(B) is that by giving some measurable dimensions to environmental values and amenities an ultimate decision on a proposed "major Federal action" can be based on an approximate social benefit/cost assessment. Some court cases have construed the purpose of §102(2)(C) statements as support for such decisions although the NEPA is basically a "full disclosure law" rather than a decision making mechanism. As was stated by the D.C. Circuit in <u>Calvert Cliffs' Coordinating Committee v. AEC</u>:

> The sweep of NEPA is extraordinarily broad, compelling consideration of any and all types of environmental impact of federal action.

However, in the same opinion the court stated that

> NEPA mandates a case-by-case balancing judgment on the part of federal agencies. In each individual case, the particular economic and technical benefits of planned action must be assessed and then weighed against the environmental costs; alternatives must be considered which would affect the balance of values.

and in Environmental Defense Fund, Inc. v. Corps of Engineers, the court asserted that it was the intent of the Congress through NEPA to require the agencies of the Federal government

> to objectively evaluate all of their projects, regardless of how much money has already been spent thereon and regardless of the degree of completion of work. (Emphasis added).

The language of certain court opinions would indicate that the Congressional intent with respect to NEPA was to assure a total social impact assessment of particular projects. However, it is also clear that the courts consider the political branches of government to be the final decision makers. The opinions also tend to recognize that elements of "judgment" must be left with the ultimate political decision makers. As noted in the EDF v. Corps of Engineers, the Court stated that:

> The methods of calculating cost-benefit ratios are innumerable and in many cases esoteric. The Court's judgment as to sound procedures in this regard might well not be in accord with the judgment of Congress.

Secretary of HEW Elliot L. Richardson has stated in this connection, we do need to "be able to measure the cost of each alternative (but) our skills in this area are seriously underdeveloped." He continues:

> The hard choices, in the end, are bound to depend on some combination of values and instincts - and, indeed, it is precisely because the content of choice cannot be reduced to a mathematical equation that we need the political forum to reach the final, most difficult decisions.
>
> To recognize this, however, reinforces the importance of being honest and explicit as possible in articulating the non-measurable considerations that transcend the limits of objective analysis.

If we accept the Richardson proposition that we need improved social cost/benefit analysis in order better to clarify policy options for decision makers but that there are limits to the analytical approach, then certain questions arise. For example, what conditions, including analytical disabilities, impose such limits? Is it the unavoidable uncertainty associated with the projection of future social environments? Is it a lack of ability to identify the effects (consequences or changes) which will result from the introduction of a proposed project into a future social environment? Is it a lack of ability to measure the probability and magnitude of such effects if identified? Is it due to a lack of ability to determine the interaction of effects (does a given effect reinforce or reduce other effects in the decisional context)? Is it a lack of conceptual ability to determine when effects must be aggregated or isolated and fragmented in order to render them "operational" for purposes of evaluating their social impacts? Is it a lack of consensus on social values or on priority social needs which precludes accord in the calculation of the social impacts of the effects of the proposed action?

The foregoing questions suggest deficiencies in future-oriented conceptual thinking and in analytical skills but are hardly satisfactory operational criteria for determining the "limits of analysis" with respect to any given problem assessment. It is likely as indicated throughout this paper that the "limits of analysis" will differ with each specific decisional context when measured, for example, by the extent to which "demonstrable data" can be effectively applied to the identification of effects of proposed projects and to approximation of their probability and magnitude or to the establishment of the conditions under which and the parameters within which realistic discretion can be exercised (or differing social value positions registered) in the establishment of normative standards. Or the question might be one of determining what effort and expense is justified in acquiring additional "demonstrable data" for a specific assessment. Will the incremental contribution such data will make to a rational process of decision justify its cost? For instance, will it reduce elements of uncertainty? When data and analysis can no longer contribute to the reduction of uncertainty as to effect identification and measurement or to the social impact evaluation of such effects or otherwise to the clarification of optional choices, then the assessing entity must resort to other less objective techniques and procedures, including various forms of adversarial system.

III. RELEVANCE OF SOCIAL JUSTICE CONCEPTS FOR SOCIAL IMPACT EVALUATION OF EFFECTS

Why must the assessor be concerned with notions of social justice? The sufficient reason is that whether effects of a given action (and their distribution) are considered social benefits or social costs and to what extent will depend upon, in varying degree, the social value perspective (notion(s) of social justice) of the participant evaluating the action outcome. By expressing, simplistically, the social impact of an identified effect as the product of the probability of the occurrence of the effect (resulting change, consequence), the magnitude of the effect (by relevant dimensions of measurement), and the degree of social desirability (or undesirability) of the effect, then it is evident that techniques for giving some measurable dimension to social desirability must be applied in the process of anticipatory project assessment. Alternative concepts of social justice reflect different preferences as to social value weight and distribution. Hence, the degree of social desirability attached to the social value (or values) associated with a given effect will differ with the social justice concepts invoked by affected participants. It is recognized that the social value orientations of most participants may be only partially explicit and by no means constitute a comprehensive rationale of political system.

Other aspects of the relationship of social justice concepts to anticipatory project assessment should be recognized in

addition to the fact that participants will make divergent evaluations of the effects of actions and projects reflecting their differing social value perspectives. In our pluralistic society there are numerous generally accepted notions of social justice including those prescribed in the Constitutional structure and otherwise formally sanctioned. The relevance or applicability of such concepts will vary somewhat with the <u>institutional arena</u> (courts, legislature, regulatory agency, executive, etc.) and the precise <u>decisional context</u> (including the arena, the issue or proposed action, the participants, the social values involved, and the alternatives open to the decisional entity). Further, what constitutes compliance with a specified social justice concept (which may have general relevance in various decisional arenas) will also vary with the precise context.

In a <u>public decision process</u> with a strong adversarial component various participants will advance different concepts or standards of social justice, often expressed narrowly and explicitly in terms of specific social interests which support a preferred decisional outcome. Further, anticipatory project assessments made by the diverse participants in the public decision process with respect to a given project may range from the most <u>exclusive</u> (and narrowly focused, often for purely partisan purposes) to the most <u>inclusive</u> (undertaken from an impartial perspective and designed to include consideration of

all affected participants and value-institutional processes). The essential point is that inclusive total social impact assessments of given projects inevitably require explicitness in selecting and identifying the social justice concept or standard (or combination thereof) by which the social costs and benefits of the assessment outcome are to be measured - if the assessment is to include social impact evaluation in addition to mere effect identification. It would not seem inaccurate to state that this aspect of assessment methodology has received scant systematic attention to date.

This is not presumed to be a simple task as the frustrations of the National Academy of Engineering's Committee on Telecommunications amply illustrate in the Committee's effort to define the public interest with respect to electromagnetic-spectrum management. The Report states in part:

> The ideal system, as defined for this search, would be a systematic procedure that could be applied to determine and assess the social and economic values associated with the spectrum management decisions. The answers obtained by such a system should be independent of those carrying out the procedures. The decisions indicated should be in the public interest and should contribute to the general welfare. Our search found no such system. It was concluded that some type of formula employing numerical values represented the only hope, but the study led to the conclusion that such an ideal system does not exist nor can it be formulated. The most basic reason for the failure of a formula approach is mathematical. A function cannot be simultaneously maximized for several dependent variables. The greatest good for the greatest number of people, or the greatest value for the least cost, simply does not exist.

This statement of exasperation is understandable under the

circumstances but does little to further the development of an adequate policy evaluative function. The Committee did consider that its work was "to a degree. . . a subcategory of technology assessment" and found its experience "well expressed" by the following paragraph of the National Academy of Sciences Report on Technology: Processes of Assessment and Choice:

> As in any problem calling for evaluation of a proposed resource allocation or distribution, the assessment of a contemplated technological development raises vexing issues of welfare economics, political theory, and ethics. Economists, philosophers, and lawyers have debated these matters among themselves and with one another for generations. Surely it would be unrealistic to suppose that this report could somehow resolve them.

Nevertheless, this analytical challenge cannot be escaped. It is crucial to the Anticipatory Project Assessment Function. The Purpose of anticipatory assessment is to clarify policy and project options in terms of their social implications in order that intelligent choices can be made by responsible political decision makers.

Yet, it is apparent that while such fundamental concepts of social justice as promotion of the "general welfare" or "equal protection of the laws" or "fairness" or provision for "maximization of individual autonomy consistent with similar exercise by all" may be prescribed as the guiding social purpose of particular actions or projects, such standards are not usually operationally adequate means of measuring and evaluating the actual outcomes of such projects. The translation of the

more general social justice concepts into explicit social value or social interest schemes will often facilitate the assessment task. Social interest schemes can be useful in suggesting possible consequences of a given action and hence, can contribute to effects identification. Such schemes can also be designed so as to reflect the social value emphasis of alternative concepts of social justice and thereby provide a means of evaluating the social impacts of the consequences of an action.

Nevertheless, should there be any lingering doubts concerning the relevance of social justice concepts to the task of total social impact assessment, reference can be made to selected existing problem areas and emerging policy decisions having clear social justice implications. Any situation involving the allocation of scarce resources raises social justice questions as, for example, selection of criteria for regulating access to the currently inadequate supply of artificial kidney (dialysis) machines, and, more generally, the selection of criteria for allocating "scarce medical care." Apportionment of costs for a given public need raises similar questions. A great variety of situations involving the "safety" factor, frequently placed in a "risk/benefit" framework, directly involve questions of what participants should be protected to what extent and at what cost to whom? The social justice implications of safety measures have been explicitly treated by the National Transportation Safety

Board. The numerous inquiries now being raised with respect to medical ethics and the patient in extremis, as well as inquiries into the implications of genetic engineering, require evaluations which are either explicitly or implicitly based upon some notions (if not systematic schemes) of social justice, and consequently, of what are social benefits, what are social costs, and how they should be distributed. Both the relevance and complexities of social justice considerations are vividly projected by the current efforts to find rational modes of establishing the "value of human life" for application in public policy planning decisions.

Every proposed action or project clearly has social justice implications, since by whatever concept of social justice applied, there will be benefits, there will be costs, and such benefits and costs will be distributed among various groups in society. Those who bear the costs of a given action are frequently not the direct or primary beneficiaries. It is also of the utmost importance to note that alternative means of achieving a specified objective may have quite different consequences for affected participants or even involve radically different groups of participants. The total social impact would thus vary with the means used to reach the specified objective. This being so, notions of social justice may strongly influence the alternative means selected.

Perhaps in most situations of anticipatory project assessment some guidance will be given the assessment entity as to the social justice concept (project objectives or criteria) to be applied to social impact evaluation. For example, statutory authority of Federal agencies will provide Statements of Policy as to what is sought to be achieved by projects performed pursuant to such authority. Frequently these policy directives are broad, ambiguous, and may encompass conflicting - if not downright contradictory - policy objectives. However, regulations of agencies and the decisions in the various arenas of legal process may provide a fairly satisfactory scheme of social objectives which can be employed by the assessing entity as social impact evaluative criteria. More specifically, Agency guidelines for the submission of Environmental Impact Statements pursuant to NEPA 1969 §102(2)(C) and Agency Requests for Proposals are sources of evaluative criteria.

Occasionally, inclusive, impartial assessment entities may be requested - or undertake on their own initiative - to make an anticipatory assessment of a proposed or potential project without guidance or limitations on criteria to be employed for social impact evaluation. It is then up to the assessing entity to develop or select and posit criteria. Such criteria would most likely reflect the "controlling" norms of the Constitutional framework, cultural traditions, and social practices, though the assessing entity may not

feel obliged to adhere strictly to these constraints. What is required is that the social justice concept employed be made explicit.

The notion of social justice has been introduced to demonstrate the relevance of social value perspective to the analytical operations of anticipatory project assessment, that is, that the evaluation of effects for social significance depends upon the social justice concept adopted for the assessment. While the public decision process in operation is frequently little more than a contest between contending parties asserting narrow, strictly partisan interests, it is certainly obligatory upon our authoritative decisional entities (courts, legislatures, regulatory agencies, administrators, etc.) to apply recognized and acceptable notions of social justice. In any event, this analysis, unless otherwise noted, will proceed from the perspective of such authoritative entities, presumably undertaking to arrive at acceptable public interest outcomes. Further, the assessment function will be viewed from the perspective of an inclusive-oriented entity, committed to providing the authoritative decisional entities with outcomes which will assist such entities to arrive at determinations consistent with specified social justice concepts. Hence, assessment entities, from this perspective, are obligated to produce outcomes in accord with explicit concepts of social justice (whether posited by the entity or otherwise prescribed). Through this approach,

assessment outcomes have meaning for all affected participants. The outcome would not be represented as the preferred course of action by the assessing entity. Its function in the public decision process is to establish an analytical standard by which other alternatives can be evaluated by affected participants in the relevant decisional context.

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II. DEVELOPMENT OF THE CONCEPT OF TECHNOLOGY ASSESSMENT

F. Generating Social Impact Scenarios: A Key Step in Making Technology Assessment Studies

Martin V. JONES

April 1972, pp. 1-18

INTRODUCTION

The assessment study is a form of planning research that seeks to anticipate the secondary social impacts that might arise from:

(1) The application from some new technology.

(2) Government or private programs to cope with a major social problem like poverty, environmental pollution, or public safety.

(3) A concerted national effort to achieve a widely supported specific goal like landing a man on the moon or finding a cure for cancer.*

From the point of view of methodology, I see nothing to gain from distinguishing among the three types of studies identified above. The process of tracing secondary reactions is pretty much the same whether the initiating force is the application of a new technology (e.g., two-way Cable TV, genetics engineering, or a revolution in food production methods) or an innovative social program (a major change in taxation, a national health insurance program, or a "landmark" Supreme Court decision relative to civil rights).

A key task in any assessment study is the generation of social impact scenarios that seek to trace in some structured fashion the interactions among various social forces. However, before an analyst is ready to generate such scenarios, he must first address three preparatory tasks that are common to all assessment studies, and, in fact, to most paper-and-pencil public policy research. These preparatory tasks are:

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* A recent MITRE paper speculates about both the potentialities and complexities that might be associated with an intensive effort to dramatically increase longevity in the United States. See: <u>Social Priorities - The Dilemma of Quality Versus Quantity</u> (Martin V. Jones - MITRE MTP-364), December 1971.

(1) IDENTIFY RELEVANT QUESTIONS. The analyst's first task is to identify and make explicit a whole host of heterogeneous essentially unstructured questions that must be answered relative to the nature of the technology or problem being assessed, and to exogenous forces that are related to the technology or problem.

(2) SYSTEMATICALLY STRUCTURE QUESTIONS. The second task is to arrange those questions systematically so that they can be a basis for hypothesizing cause-effect, problem-solution, action-consequence relationships.

(3) COLLECT DATA. The analyst's ability to draw inferences, however, depends upon his ability to develop answers to the specific questions that he has identified and structured in the first and second steps. This means that he must collect data that will guide his intuitive judgements in deriving these answers.

Before proceeding further, it should be noted that the notion of assessment studies is not new. For years, disciplinary research has produced assessment studies. Economists have made assessments of the impacts of new legislation (e.g., tax measures) on the national income level, market researchers have assessed the impacts of new products on a company's sales, sociologists have assessed the impact of a proposed change in the parole system on the crime rate, educators have assessed the impacts of a major curriculum innovation on student achievement, etc.

Similarly, interdisciplinary analyses in recent years have "assessed" the comparative merits and shortcomings of alternative courses of action for solving or alleviating specific problems. In the category of this interdisciplinary research there has been operations research, cost-benefit analysis, cost-effectiveness analysis, systems analysis, management science, computer simulation, the Program

Evaluation and Review Technique, the Program-Planning-Budgeting system, and the so-called "Policy Sciences."

However, a major characteristic of most of this disciplinary and interdisciplinary research is that it has sought answers to a relatively narrow list of questions. Economists have usually confined their efforts to appraising the impact of a particular measure on the nation's economic well being, market researchers have primarily been concerned with the effect that a new product would have on a particular company's or industry's sales or profit position. By the same token, most interdisciplinary studies have compressed the entire decision-making criterion into some simple cost-performance ratio, i.e., the dollar cost per patient serviced in a medical treatment center.

One way of describing the contribution of the technology assessment movement is to refer back to the first of the three analytical tasks listed at the beginning of this paper. Those who have pioneered the technology assessment movement have insisted that the analyst must vastly increase the scope and the number of questions to which he seeks to develop answers. This point has been succinctly stated by Professor Mayo:

> Perhaps the most significant aspect of the concept of technology assessment is that it is, and is meant to be, consistent with the notion of Total Impact Assessments, i.e., the identification of all social impacts of a particular application rather than selected impacts. *

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* Louis H. Mayo, Scientific Method, Adversarial System, and Technology Assessment, November 1970, Program of Policy Studies in Science and Technology, George Washington University Monograph No. 5, p. 3.

THE MITRE-OST PROJECT

I believe that our recent MITRE methodological studies for OST made a first step toward addressing in a generic context the first two tasks listed above. First, we tried to suggest, as comprehensively and as explicitly as time would allow, how the concept "total impact analysis" might be defined. In defining "relevant considerations" we consolidated lists of highly diverse societal characteristics in a somewhat different way than, to our knowledge, has therefore been done in either disciplinary or interdisciplinary studies. In so doing we drew extensively from the published research of others in many fields for the component items of our lists. These lists of societal characteristics - covering such matters as values and goals, demography, environment, economic factors, social elements, and institutional parameters - provided a beginning master list of areas of interest about which the analyst should raise questions when he begins the process of making a total impact assessment study.

In the MITRE-OST study we also tried to contribute in a generic way to the second task identified at the beginning of the paper. We provided a seven-step procedure which, we believe, can help an analyst to integrate the diverse checklists of questions so that he can begin to trace in a comprehensive fashion the initial and secondary impacts of any major technological application or of society's attempts to respond to or redirect that application. Exhibit 1 provides an analytical overview of the seven-step procedure and some of the supporting checklists.

SCOPE OF STUDY

BREADTH OF STUDY	DEPTH TO WHICH STUDY COVERS TOPIC: MAJOR	MINOR	NONE
RANGE OF TECHNOLOGIES			
RANGE OF TOPICS			
GROUPS AFFECTED			
TIME PERIOD ANALYZED			
TYPES OF IMPACTS			
LEVELS OF IMPACTS			
IMPACT MEASUREMENTS			

STEP 1

TECHNOLOGY DESCRIPTION BACKGROUND STATEMENT

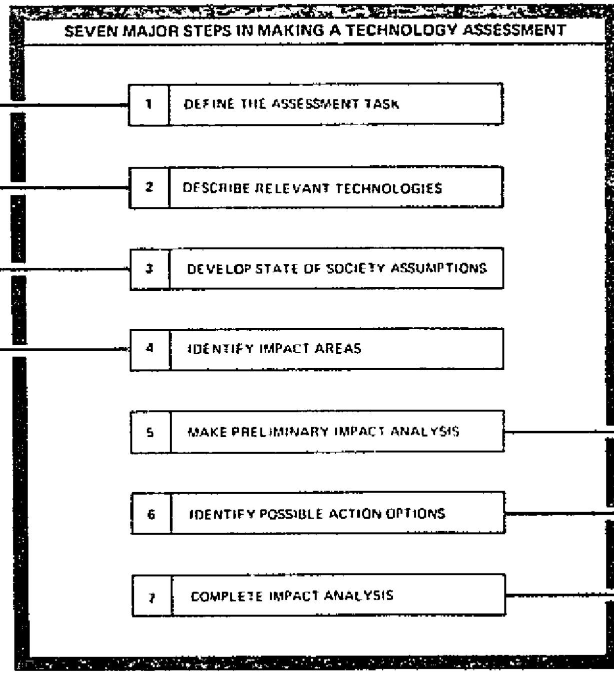
MATTERS ADDRESSED	COVERAGE
1 PHYSICAL AND FUNCTIONAL DESCRIPTION	
2 CURRENT STATE OF THE ART	
3 INFLUENCING FACTORS	
4 RELATED TECHNOLOGIES	
5 FUTURE STATE OF THE ART	
6 USES AND APPLICATIONS	

STEP 2

STATE-OF-SOCIETY AND MAJOR IMPACT CATEGORIES

CATEGORIES	TYPES
VALUES	
ENVIRONMENT	
DEMOGRAPHY	
ECONOMIC	
SOCIAL	
INSTITUTIONS	

STEPS 3 AND 4



ACTION OPTION EVALUATION CRITERIA

CRITERIA	DEFINITION
1 CONTROLLABILITY	
2 WORTH	
3 PRIORITY	
4 EFFECTIVENESS	
5 COST (SPONSOR)	
6 COST (SPILLOVER)	
7 NON-FINANCIAL PROBLEMS	
8 INSTITUTIONAL OBSTACLES	
9 UNCERTAINTY	

STEP 6

KEY IMPACT COMPARISON WITH AND WITHOUT ACTION OPTIONS

TECHNOLOGY	
DEVELOPMENT	
APPLICATION	

SOCIETAL IMPACT	
SOCIETAL IMPACT	

ACTION OPTION	
BRIEF DESCRIPTION	

IMPACT CHARACTERISTICS	IMPACT: WITHOUT ACTION OPTION	WITH ACTION OPTION
AFFECTED GROUP		
HOW AFFECTED		
LIKELIHOOD		
TIMING		
MAGNITUDE		
DURATION		
DIFFUSION		
SOURCE		
CONTROLLABILITY		

STEPS 5 AND 7

This set of displays extracts portions of the selected checklists used in the MITRE studies for OST to summarize important aspects of the technology assessment methodology. The seven steps listed in the center of the page depict the total methodology.

The key questions that must be addressed in accomplishing each of the seven steps are shown in the remaining exhibits. Some of the exhibits apply to two steps rather than one—e.g., the third and fourth steps and the fifth and seventh steps are displayed together. Each step and its applicable key questions are discussed in separate chapters of the MITRE study.

EXHIBIT 1
TECHNOLOGY ASSESSMENT:
A METHODOLOGICAL OVERVIEW

ILLUSTRATIVE SOCIAL-IMPACT SCENARIOS

During the last year our thinking at MITRE has moved toward increasingly explicit social impact scenarios. Most of the scenarios in the study for OST were essentially simple and qualitative. For instance, Exhibit 2 lists in a relatively straightforward manner a partial series of historical events following the introduction of man-made fabrics. Exhibit 3 uses a flow-diagram technique to depict some multidimensional impacts that might follow an accelerated automation in industry. Exhibit 4 in a similar way depicts some consequences that might ensue if mariculture (sea-farming) were successfully applied to reduce malnutrition in developing countries.

In Exhibit 5 we speculate about one set of consequences that might follow the introduction of two-way Cable TV in major cities. This exhibit elaborates the scenario process by documenting the rationale that led us to hypothesize the series of events shown.

In Exhibit 6 we carry the methodology substantially further in that:

(1) we attach four important qualifying and elaborating bits of information to each successive event:

 (a) how <u>probable</u> is it that the interaction will, in fact, occur?

 (b) in what <u>direction</u> will the interaction occur, i.e., will the happening of the earlier event cause the later event to increase or decrease?

 (c) what will likely be the <u>magnitude</u> of the interaction if it occurs?

 (d) what will be the <u>timing</u> of the interaction? How long after the earlier event will the later event occur?

(2) we show multiple consequences flowing from one prior event rather than a single consequence.

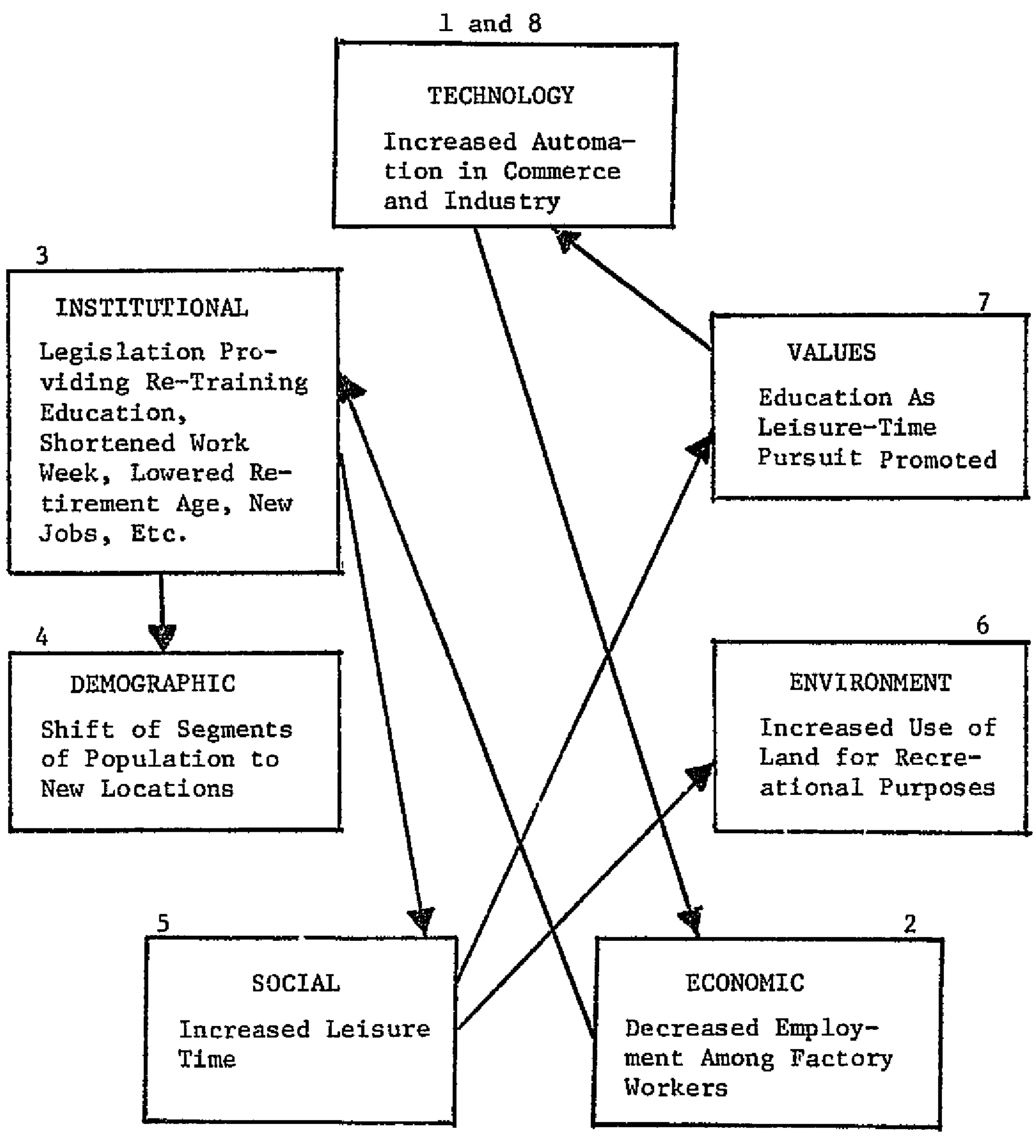
EXHIBIT 2

SELECTED IMPACTS OF THE INTRODUCTION OF MAN-MADE FABRICS ON CITIES

less use of cotton in clothing manufacture
decline in sales of U. S. grown cotton
reduced employment opportunities for unskilled blacks in southern cotton fields
stimulated migration of southern blacks to northern cities
great expansion of welfare costs in northern cities
financial crises in northern cities involving huge increases in city obligations without commensurate increases in the tax base and revenues
steady exodus of northern urban whites to suburbs
increasing political influence of non-whites in northern cities
election of black officials in northern cities

EXHIBIT 3

SOME POSSIBLE CONSEQUENCES
OF A RAPID INCREASE IN INDUSTRIAL AUTOMATION



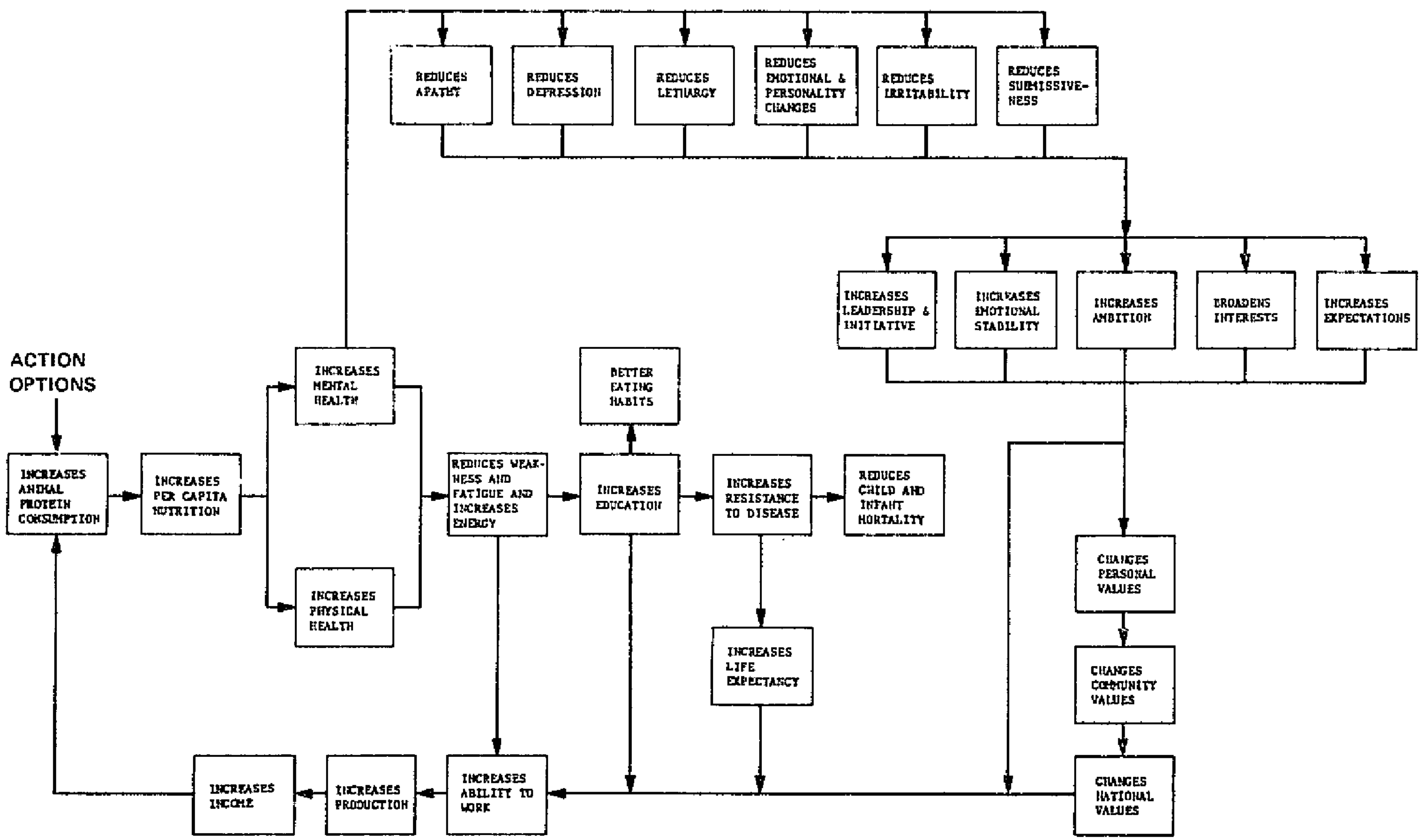


EXHIBIT 4

IMPACTS SUBSEQUENT TO THE REDUCTION OF MALNUTRITION FOLLOWING MARICULTURE APPLICATION IN DEVELOPING COUNTRIES

1

TECHNOLOGY

Interactive TV is applied increasingly to make available to inner-city children a quality of education equaling that provided by suburban school systems.

2

DEMOGRAPHY

Historically, the urge to obtain better education for their children has been one of the leading incentives in causing many of the more ambitious inner-city families (both white and black) to move to the suburbs. By providing better education to inner-city children, interactive TV may slow down or halt the population exodus to the suburbs.

3

ENVIRONMENT

If the more ambitious, articulate families decide to stay in the city, they will take steps to insure that the urban environment be cleaned up relative to air purity, noise, aesthetic nuisances, etc.

4

SOCIAL

These same families, if they decide to stay in the city, will also insist that more aggressive steps be taken to rid the inner-city of major social problems such as drug addiction, crime, etc.

5

INSTITUTIONS

Major overhauls in the structure of local government may be brought about if aggressive efforts are made to clean up both the physical and social environments of the inner-city while at the same time making the total urban political process more responsive to an articulate citizenery.

6

ECONOMIC

The economic prosperity of the inner-city will be enhanced because fewer of the articulate, relatively affluent families will be leaving. This may halt, and even reverse, the steady erosion of the tax base that most major cities have suffered in the last several decades.

7

VALUES

The U. S. has frequently been labeled the "throw-away" society and often citizens have seemed to prize newness for newness sake in their housing, automobiles, and other material possessions. This tendency may be substantially reduced if thousands of ambitious inner-city families decide to renovate and refurnish their existing older homes, community facilities, etc.

EXHIBIT 5

ONE SET OF CONSEQUENCES OF INTRODUCING TWO-WAY CABLE TV IN LARGE CITIES

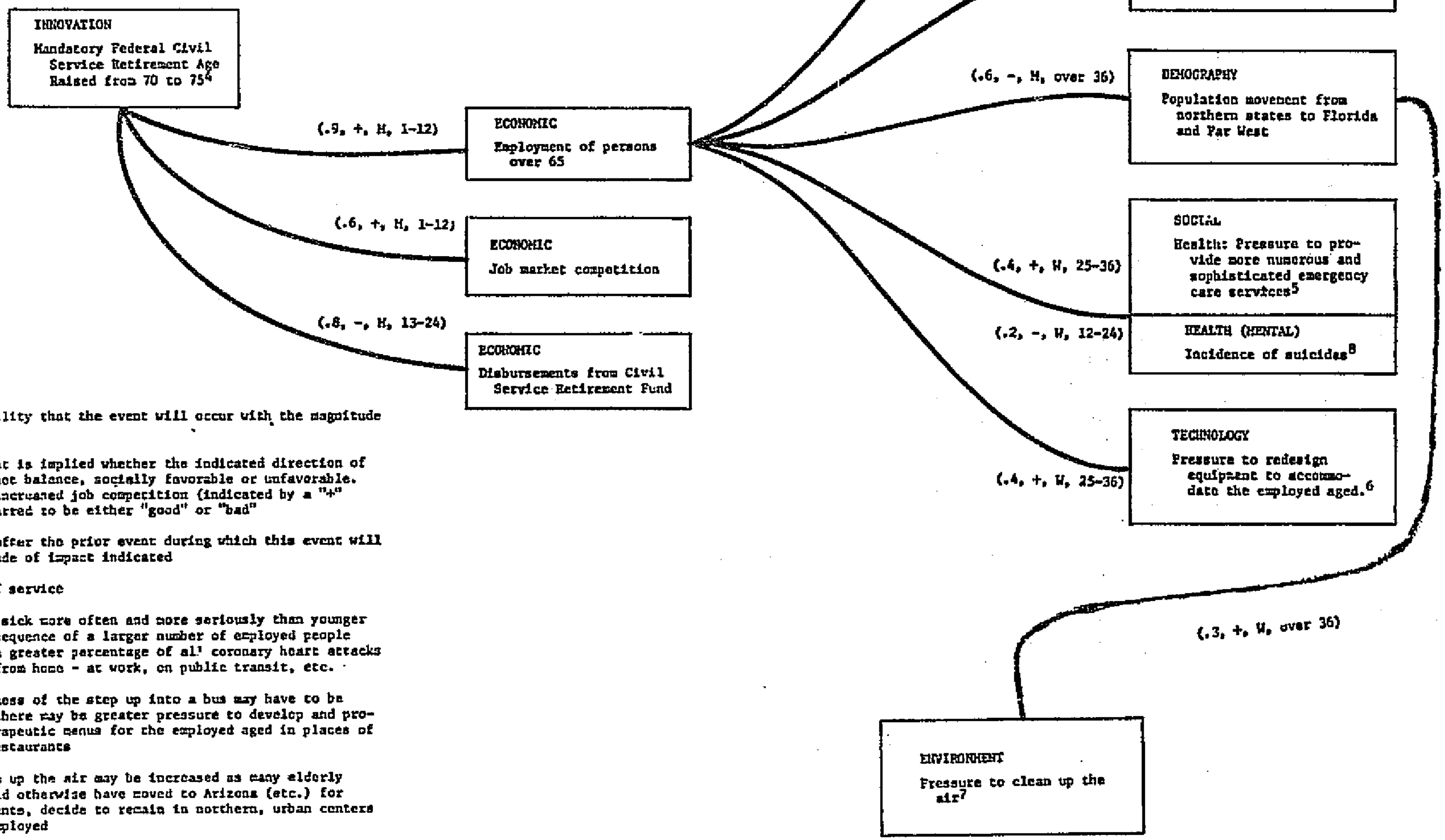
C-3

Code:

Probability of Occurrence[1]	Direction of Change[2]
From 0.1 to 1.0	+ Increase - Decrease
Magnitude of Change	**Timing[3]**
S - Strong M - Moderate W - Weak	1-12 Months 13-24 Months 25-36 Months Over 35 Months

EXHIBIT 6

SOME REPERCUSSIONS THAT MIGHT FOLLOW FROM RAISING THE MANDATORY CIVIL SERVICE RETIREMENT AGE



NOTES:

1 Estimated probability that the event will occur with the magnitude and timing shown.

2 No value judgement is implied whether the indicated direction of movement is, on net balance, socially favorable or unfavorable. In other words, increased job competition (indicated by a "+" sign) is not inferred to be either "good" or "bad"

3 The time period after the prior event during which this event will reach the magnitude of impact indicated

4 After 15 years of service

5 Older people get sick more often and more seriously than younger people. One consequence of a larger number of employed people over 65 is that a greater percentage of all coronary heart attacks will occur away from home - at work, on public transit, etc.

6 E. g. The steepness of the step up into a bus may have to be reduced. Also, there may be greater pressure to develop and provide special therapeutic menus for the employed aged in places of employment and restaurants

7 Pressure to clean up the air may be increased as many elderly persons, who would otherwise have moved to Arizona (etc.) for respiratory ailments, decide to remain in northern, urban centers where they are employed

8 There is, for a variety of reasons, a higher incidence of suicides among elderly people than among the population generally. The raising of morale as a result of the subject innovation should reduce suicides in this age group

POSSIBLE METHODOLOGICAL REFINEMENTS

There is, as I see it, a distinct advantage to the increasingly explicit scenarios as one moves from Exhibit 2 through 6. A scenario, like Exhibit 6, is much more informative as to exactly what conditions an analyst is, in fact, projecting. Traditionally, a shortcoming of many scenarios and projections is their non-explicitness. Because it is both explicit and discrete, a scenario, like Exhibit 6, makes it possible for other analysts to concur with, or take exception to, specific entries in the scenario without having to accept or reject the scenario totally.

Although Exhibit 6 is much more informative than Exhibit 2 or 3, Exhibit 6 is also simplified as to the scope of information that should ideally be shown in this type scenario. For instance:

(1) Other factors that would either reinforce or dampen the specified sequential relationships should be included in the scenario. For instance, in Exhibit 6 disbursements from the Civil Service Retirement Fund are likely to be influenced by many other factors besides changes in the mandatory retirement age - e.g., changes in the number of persons reaching 65 years of age, changes in the price level, etc.

(2) Exhibit 6 shows only 11 interactions. A scenario that truly aimed to model the real world might require 50, 100, or more interactions. For instance, if the movement of the aged to Florida and the Far West were slowed, this would lead to (+) impacts on the economic prosperity and the political power of northern states vs. Florida and the Far West. Similarly, lower-level impacts might be anticipated - the demand for winter clothing would be increased and that for golf and fishing equipment reduced.

(3) Exhibit 6 shows only one-way interactions. An indepth scenario would aim to include dual or two-way interactions, e.g., not only do economic events influence demography, but demographic events cause economic impacts.

(4) Obviously, in any given case, what is required is not a single scenario, but a whole series of them. The qualifying coefficients to the events specified in Exhibit 6 are all single-valued. However, each of the matters covered is characterized by uncertainty. An alternative scenario is needed to trace the chain of consequences if a given probability of occurrence were to change from, say, 0.9 to 0.5, or, if, the magnitude of change were to be weak instead of strong, or the timing 25-36 months instead of 1-12 months.

(5) The qualifying descriptive bits of information attached to each sequential event should be expanded beyond the four shown in Exhibit 6 - probability of occurrence, direction, magnitude, and timing of impacts. Other information that might be shown includes: the duration of the impact, the diffusion of it across society totally or among members of a specified target group,* and the estimated extent to which the impact may be amenable to social control.

Research in developing more explicit, sophisticated scenarios should be accompanied by parametric empirical research that would

* For instance, the "aged" are not a monolithic group. Some are rich, others are poor; some are well, others are sick; some desire to work, others do not; some are highly trained, others are unskilled; some are married, others are not; some live in cities, others on farms, etc. The specific impact that a new technology or social program would have would vary greatly according to the socio-economic condition of the aged person involved.

help an analyst estimate the probability, direction, magnitude, timing, etc. of the various entries in the scenarios. For instance, a major initial concern is whether the period of application of a new technology will be quick and short or slow and protracted. Exhibit 7 lists some of the factors that can influence the length of this application period. Similar parametric lists should be developed that would help an analyst to estimate the probability, direction, magnitude, and timing of the secondary consequences that follow from the initial application of the innovation.

Going beyond the qualitative parametric relationships just cited, the next step is to quantify the relationships, wherever possible. The MITRE reports for OST cited, illustratively, a wide variety of such quantitative relationships that have been developed in many fields -- economics, demography, environment, public safety, health, etc. (See: Volume 1, pp. 87-92). As one specific example, Exhibit 8 extracts a small portion of a computer analysis that was conducted for the MITRE mariculture pilot assessment study. This analysis projects quantitatively the potential impacts on 26 different socio-economic-environmental conditions of mariculture applications in 67 developing countries.

EXHIBIT 7

FACTORS THAT WILL INFLUENCE HOW LONG IT WILL TAKE TO APPLY A NEW TECHNOLOGY

FACTORS	EXPLANATION
People vs. Things	If a new technology initially impacts on the material world, such as the transistor did, there will probably be less delay in its widespread adoption than if it impacts in a major way on people physiologically. There almost surely will be a delay if the product is one that people would ingest, as a new powerful drug, that might have serious adverse side effects.
Nature of Decision Making	Centralized decision making, such as in the military or space programs, is conducive to more rapid application than diffused decision making involving many checks and balances, as is currently the situation in certain new health technologies.
National Commitment	If the new technology would satisfy a "crying need" (a cure for cancer) or a national goal (to land a man on the moon), there will normally be a tendency to assume risks or surmount obstacles that would otherwise block or delay an application.
Reward for Innovator	Since most innovations in our private enterprise economy are made by entrepreneurs, how the rate of application affects entrepreneurial profits is important. Sometimes, for various reasons, it has been in the interest of the innovator (e.g., Corfam, substitute for leather) to prolong the application period. In other cases, where imitation has been easy and product differentiation difficult (as in the fashion field), there has been a tendency to exploit the market quickly.
Capital Required	All other things being equal, the larger the capital investment required, the more restricted the number of organizations that can participate in the application, and hence, the slower the rate of application. The increasing capital investment required for the development of birth control devices is one of the reasons that the period of application of new technology in this field may lengthen.
Competition	Closely linked to several prior considerations is the extent of competition in both research and production. In many industries, smaller companies whose fortunes in the industry are rising set the pace for rapid application of new technology. In other industries where the industry structure is stabilized or moribund, innovation is slow.
Institutional Climate	Again, similar to several of the above, the extent to which vested interests can conspire to stymie innovation will greatly influence the rate at which innovation is applied. The building industry is, of course, the classic case where contractors, labor unions, and local building codes have for all practical purposes throttled major innovations.

EXHIBIT 8

SOME ANTICIPATED IMPACTS RESULTING FROM MARICULTURE APPLICATION IN 67 DEVELOPING COUNTRIES*

IMPACT AREAS	UNITS OF MEASURE	1975	1980	1985	1989
Mariculture Acreage	Millions	16	31	38	42
Mariculture Production (Total)	Millions of Tons	2.0	9.5	17.0	19.0
Mariculture Production (Exported)	Millions of Tons	2.0	9.0	14.0	14.0
Value: Mariculture Export	Billions of Dollars	9.3	42.0	55.3	65.3
Jobs Created by Mariculture	Millions	3.84	7.44	9.12	10.08
Income from Mariculture (%)	% of Nat. Income	0.6	1.9	2.2	1.9
Annual Protein from Mariculture	% of Total Consumed	0	2.0	9.0	13.0
Malnutrition Abated	Millions of Cases	0	75	449	748
Infant Deaths Prevented	Millions of Cases	0	37	224	37[illegible]
Training Required	Millions of Hours	96	186	228	252
Water Pollution Index	Index Number**	25.5	31.0	37.6	44.2

* This is an abridged version of one of twelve different scenarios that were generated in the MITRE Mariculture Pilot Study. Each scenario reported on 26 different impact areas as compared to the 12 impact areas shown above. The different scenarios reflected the effects of varying the mariculture acreage and the production yield per acre.

** Low number is good; high number is bad.

DATA COLLECTION

In the first and second tasks leading up to the social-impact scenarios that we have discussed thus far, we illustrated some of the social characteristics that should be related in an assessment study. We also identified, again illustratively, some of the parameters - like probability of occurrence, direction of change, magnitude of change, and timing of occurrence - that should be traced for each of the interrelated factors. The third task is to collect data that will make it possible to assign the coefficients to these parameters in any given case. Should the probability of occurrence of one event following another be designated 0.1, 0.5, or 0.9? Should the timing be placed in the 0-12 months range, 13-24 months, or over three years?

The MITRE study for OST, primarily because of time limitations, did not explore this issue of data collection to the same extent as it did the first two tasks, identifying the questions to be addressed and structuring these questions systematically for analytical purposes. Actually the task of collecting data for a technological assessment study is not essentially different than that of any other future-oriented, public-policy-issue, paper-and-pencil study. Probably the major difference, as noted previously, is that in an assessment study information would have to be collected on a much wider variety of matters -- values, demography, economics, environment, social issues, and institutional considerations -- than in a typical disciplinary or even interdisciplinary cost/benefit study. For some of these matters - like values and institutional considerations - it is also more difficult to collect "hard data" than it is in the typical economic research or market analysis survey.

However, rarely, for any of these matters is the choice one of data vs. no data at all. It is rather one of data of various shades of relevance and validity. It may also be a question of documented

data vs. undocumented ("expert opinion," "authorative source") data. Other things being equal, documented data are preferred to undocumented data because it is normally easier to doublecheck and verify documented data. However, often other things are not equal. For instance, in dealing with new somewhat unique projects, undocumented expert opinion data may sometimes be just as good or better than documented data because the so-called undocumented data are more current and relevant. For instance, a carefully developed "guesstimate" from a well-known gerontologist might provide a sounder estimating base relative to the effect on senior citizen productivity and morale of raising the compulsory retirement age in the United States than would a written report prepared at an earlier date in a different country with a somewhat different cultural heritage. In recent years new methods have been developed for systematically reaching a consensus of expert opinion on a given subject, including future forecasts. The best known of these methods is the Delphi Technique.

In searching for data, the assessment analyst should make use of all of the analytical techniques that economic, technological, and other forecasters have been using for years. There is no point to discuss these techniques in detail here. The MITRE study for OST (Volume 1, Chapter XII) has a brief chapter on forecasting, and, of course, the literature abounds with long books on the subject. As a source of possible interest relative to my own views on forecasting methods, I have reproduced in Exhibit 9 a one-page recap of forecasting methods that appeared in the referenced chapter.

In the realm of documented data, the conventional planning factor which expresses the quantitative historical relationship between one type of event and another is certainly a useful forecasting tool for the assessment analyst in tracing both the timing and magnitude of societal interactions. Economists, of course, have a large inventory

EXHIBIT 9

A RECAP OF FORECASTING METHODS
(Hypothetical Question: What Percentage of U.S. Physicians Will Use Computer Diagnostic Services by 1985?)

FORECASTING METHODS	
DEFINITION	EXAMPLE
<u>INTUITION</u> A forecast based on the subjective judgment of the forecaster.	Experts at an extemporaneous workshop session of a joint physician, computer-industry symposium predict that by 1985 approximately 65% of U. S. physicians will employ computer diagnostic services. They cite as evidence the increasing experimentation with the use of automated techniques in the medical profession.
<u>TREND EXTRAPOLATION</u> A forecast based on the assumption of the continuation into the future of some discerned past trend.	Statistics show that over the past 15 years the percentage of physicians using computer diagnostic services increased from 4 to 27%. Continuing that trend for the next 15 years indicates that by 1985 approximately 65% of physicians will employ computer diagnostic services.
<u>TREND CORRELATION</u> A forecast of the future status of some phenomenon in terms of a consistent relationship of that phenomenon to some other phenomenon in the past whose future status has already been projected.	Historical data covering the last 10 years show that the percentage of physicians with access to computer diagnostic consultation is well correlated with three other factors: the increase in private group medical practice, the percentage of the population covered by medical insurance, and the percentage of doctors graduated from medical schools offering instruction in medical applications of computers. Projections on these three factors are available through 1985. Using these projections as a basis, a statistical correlation analysis indicates that by 1985 65% of physicians will have access to computer diagnostic consultation.
<u>MODELS (STATISTICAL)</u> This method is a much elaborated version of the historical trend correlation technique described above. It often involves the use of dozens, and sometimes of hundreds, of estimating equations--all integrated into a unified forecasting method.	An in depth study of physicians who have already adopted computer diagnostic consultation services shows that such usage is related in a complex way to some 10 different variables such as physician work load, degree of medical specialization, the access to and use of other consultative services, the cost of the computer service, etc. Well documented studies make it possible to predict the growth factor through 1985 for these 10 governing variables. Using this later study and the cited historical relationship, it is possible to predict that 65% of physicians will employ computer diagnostic consultation in 1985.
<u>ANALOGY</u> This method predicts the future by drawing a plausible parallel between the future and some presumably similar prior event.	In terms of many management and scientific services the medical research field has been about 25 years ahead of the practicing physician. In 1960 approximately 65% of the nation's medical research facilities were using computers for data analysis and synthesis tasks similar to those involved in physician computer diagnostic consultation. On this basis it is predicted that by 1985 approximately 65% of physicians will employ computer diagnostic consultation services.

of such relationships that are expressed in "multiplier" and "acceleration" principles. Usually these factors express the quantitative relationships between investment, production, employment, income, spending, etc. There are also temporal relationships involving market and social behavior. For instance, changes in wholesale prices usually precede changes in retail prices by several months. Demographers, environmentalists, sociologists, medical technicians, traffic engineers, and other specialists have similar inventories of rule-of-thumb planning relationships.

The appropriate caveats applying to such relationships are well known. All such relationships are developed from historical (hopefully analogous) experience. Since we can say for sure that the future will seldom be a carbon copy of the past, at best, such historical relationships can be taken only as approximate guides to future relationships. Also, in most cases these quantitative relationships only describe the past in highly gross terms. In spite of the arithmetic precision with which these relationships are often expressed, they usually are simple averages that conceal much variation, and sometimes experts even disagree as to what the average historical relationships are. Notwithstanding these caveats, the assessment analyst must use these planning factors. If he discards them completely, he is left with nothing but unadulterated intuition and heresay, and normally he has no sound basis for selecting one unsupported intuitive judgement over another.

In the months ahead, we at MITRE hope to explore further the possibilities of new methods of data generation for making assessment studies.

II. DEVELOPMENT OF THE CONCEPT OF TECHNOLOGY ASSESSMENT

G. Proposal to the National Science Foundation for a Retrospective Technology Assessment of Submarine Telegraphy

Vary T. COATES and
Bernard S. FINN

November 1974, pp. 1-6; 25-27

PROPOSAL
for

RETROSPECTIVE TECHNOLOGY ASSESSMENT: SUBMARINE TELEGRAPHY

The Program of Policy Studies (PPS) proposes to conduct a retrospective Technology Assessment of Submarine Telegraphy, in response to NSF Program Solicitation 74-34. Co-Principal Investigators for the project would be Dr. Vary T. Coates, a political scientist and Associate Director and Head of the Program's Technology Assessment Group; and Dr. Bernard S. Finn, Curator (Electricity) of the Smithsonian's Museum of History and Technology who is conducting a definitive historical study of submarine telegraphy.

The proposal covers the following topics:

SECTION I. INTRODUCTION

Technology Assessment is interdisciplinary, problem-oriented research, intended to provide a firm scientific/technological information base in support of decisionmaking and policy formulation. As a way of analyzing complex problems Technology Assessment seeks to combine (a) the quantitative methodologies developed in Systems Analysis, Operations Research, and physical

sciences and (b) the methods of behavioral analysis developed within the social sciences with (c) the analytical tools used in the policy sciences.

Technology Assessment as a formal, organized activity began in the late 1960's. The body of experience in this area is not large, although it is now accumulating rapidly, largely as a result of NSF-funded comprehensive assessments during the last two to four years. Methodologies have been innovated or adapted from related fields of inquiry to fit the technology or problem definition of Assessments as found necessary and appropriate by the investigating teams and project sponsors.

At this stage of development it is appropriate that the state of the art of Technology Assessment methodologies should be evaluated and some tentative conclusions advanced as to their adequacy, appropriateness, warrantability, and effectiveness. This endeavor poses theoretical problems because Technology Assessment is an anticipatory activity. Most technology-oriented Assessments have dealt with new and emerging technologies, of which the full range of societal impacts has not yet been realized. Testing the results and evaluating the findings of recent Technology Assessments therefore cannot be done empirically until such period as the predicted consequences do or do not occur as anticipated.

At that time, some years in the future, another problem will arise: an effective Assessment -- that is, one which successfully influenced the direction of policy formulation and decisionmaking -- will have provided the means for avoiding possible detrimental outcomes which it was able to anticipate. Thus it will have changed the future, the Assessment's effective anticipation of which is to be evaluated; this is the reverse of the classical problem of self-fulfilling prophecies.

A. Objectives of Retrospective Technology Assessment.

Retrospective Technology Assessment offers one way to avoid this dilemma. Choosing a technological development which began far enough in the past for its societal impacts to have matured and be widely disseminated, one would attempt to identify and measure these impacts and determine the extent to which they were predictable during the period of inception of the technology, given the state of knowledge and the investigative and analytical tools then available. One would also investigate the extent to which analytical techniques available today would have enhanced the potential for anticipating and measuring such impacts.

This statement of objectives obscures a number of pitfalls and fallacies which may lie in wait for the unwary investigator and which may be both theoretical and practical. There is an assumption that societal impacts which later developed can be regarded as inevitable (aside from their predictability or identifiability) -- that is, there is an assumption of a simple cause-effect relationship rather than randomness or the effect of highly involved concatenations of converging trends. The concept of retrospective Technology Assessment may also conceal an unstated presumption that there are close analogies between the course of past technological developments (and their unplanned societal consequences), and those likely to occur at present or in the future. This is an hypothesis which badly needs empirical investigation, and any contribution to this effort may in fact be the most valuable byproduct of retrospective Assessments. Some Technology Assessment methodology, such as Delphi and other consensual techniques, can not be applied retrospectively, although some adaptation, such as role playing, might be attempted.

Technology Assessment has developed under the handicap of a major theoretical deficiency, namely, the lack of an appropriate and useful model

of the relationship between technological change and social change. No one retrospective assessment is likely to produce a universally acceptable model; however, cumulative experience in retrospective assessment may make substantial contributions to development of a model. It should be noted in passing that much retrospective Technology Assessment is implicit in the literature of the history of science and technology, and in a few cases retrospective assessments have been attempted on a preliminary and tentative basis; see, for example, an early Program of Policy Studies publication, "Early Experiences with the Hazards of Medical Use of X-Rays: 1896-1906 -- a Technology Assessment Case Study," by Barbara S. Marx (1968); and The Railroad and the Space Program: An Exercise in Historical Analogy, Bruce Mazlich (ed.), MIT Press (1965).

Two safeguards against the pitfalls of retrospective Technology Assessment are especially important: involvement of trained and experienced historians of technology, and careful formulation of the questions to be asked. Tentatively, the investigation should ask at a minimum (terms used are deliberately anachronistic):

- What assessments or forecasts of impacts were made at the period of the inception of the technology?
- What formal and informal techniques were used in making such forecasts?
- What unplanned consequences or societal impacts resulted from the technology?
- To what extent were they inevitable given the technology and its eventual level of dissemination and use?
- To what extent were contemporary forecasts (if any) correct and inclusive?
- To what extent did contemporary forecasts (if any) prevent or enhance the consequences which were anticipated?

- To what extent were other consequences, which were not predicted, in fact potentially predictable, given the knowledge of the physical universe then available?
- To what extent would they have been predictable given the subsequent advances in physical and social sciences and analytical methods?
- If predictable, could the eventual impacts have been altered (either modified, avoided, or enhanced) by policy intervention?

B. Criteria for Selection of a Subject for Retrospective Technology Assessment

On the basis of this reasoning, PPS has postulated the following minimum criteria for selection of a technological development for retrospective assessment:

(a) The technology selected should be amenable to historical investigation and description.

It should be one which originated in a discrete and definable technological innovation within the designated time period (roughly, the last century). Contemporary records of its inception and the subsequent course of its technical development, dissemination, utilization, and societal impacts must exist and be accessible to the retrospective assessors.

(b) The technology should be one which provided a significant new capability, or an order of magnitude improvement in historical capability.

(c) The technology should be one which is (in 1974) mature and widely utilized.

(d) The societal consequences should provide a rich and textured field of investigation -- that is, it should have produced significant and measurable impacts over a range of aspects of society: impacts which

can be clearly attributed to the subject technology.

(e) There should exist an historical record of "assessment," that is, formal or informal predictions from knowledgeable contemporary sources as to its potential costs and benefits.

(f) Preferably the technology should be one which was viewed at its inception as provocative or controversial because of its potential impacts; and this controversy should have had policy implication.

SECTION II: RATIONALE FOR A RETROSPECTIVE TECHNOLOGY ASSESSMENT OF SUBMARINE TELEGRAPHY

> Since the discovery of Columbus nothing has been done in any degree comparable to the vast enlargement which has thus been given to the sphere of human activity.
>
> -- The (London) Times, 6 August 1858

A. Submarine Telegraphy as Subject of Retrospective Technology Assessment

Until 1865 the swiftest communication possible between North America and Europe was about two weeks (Fig. 1, p. 6a). With the laying of the first successful transAtlantic cable, this was reduced to a matter of minutes. This achievement, barely twenty years after the first electronic long-distance communication, demonstrates that submarine telegraphy provided a significant new capability to human activity (though perhaps not, as the Times enthusiastically proclaimed, the most vast since the discovery of the New World). Though seriously challenged in the 1920's by radio, and more recently by satellite communication, submarine telegraphy -- having undergone a major transformation of its technology with the laying of the first repeater cable in 1956 -- is today a highly utilized, mature, but still developing technology.

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*The Lightning set the record -- 13 days, 19 1/2 hours, from Boston to Liverpool on her maiden voyage in 1854.

appear in the following decade had even greater band-width capabilities.

The result has been that less than two decades after the laying of the first transAtlantic cable with repeaters the old long distance telegraph cables have been abandoned, the specialized equipment dispersed and the techniques discarded.

(e) Potential Contributions of the Study

Subjectivity must enter as taxonomies of impact dimensions and factors are defined and associated to infer impacts; we cannot relive yesterday nor recreate nineteenth century man. This is a fundamental limitation to all retrospective Technology Assessments. However, all assessment procedures use generalized past experience and scientific knowledge in order to sketch the anticipated pattern of likely future developments. Therefore, retrospective Technology Assessments should sharpen our understanding of past events, the degree of novelty of the present, and the degree of uncertainty inherent in contemporary assessments.

The exploratory retrospective Technology Assessment of submarine telegraphy could contribute to important understanding in the following regards:

- The degree to which intuitive or unsystematic expressions of probable benefits and negative impacts in reality anticipated the true consequences and avoided worse consequences than those which ensued.

- A measure of the likelihood of anticipating consequences when measured by their degree of novelty with respect to dominant trends and supposed invariant principles of behavior. Are most significant consequences so unique and unprecedented that prediction is unlikely; is the increase in complexity of the decision process and the companion business world or political arena as well as the articulated societal interrelationships a major factor in being able to assess and respond to consequences?

- An understanding of the mechanisms by which anticipated consequences affected or did not affect policy.

- Whether or not considerations of completeness and thorough analysis in establishing the taxonomy of impact dimensions and factors, in scanning the interrelationships between factors and the self-consistency of implicit scenarios, and the affect on related technologies and ventures would have been sufficient by themselves to greatly improve assessment performance and hence the consequences of introducing the technology.

- The degree, the mechanism, and the timing of the involvement of impacted groups into the decision process as related to the intensity of detrimental (beneficial) impacts; did most groups become aware of the impacts long after the critical decision point had been passed?

- The changing character of the consequences of the technology in the successive stages of development; i.e., invention, promotion, and approval; implementation and diffusion; growth and dominance; maturity to homeostasis and subordination to the next generation of technologies.

Technology Assessment evolved as an articulation of an ever more complex decision process within an ever more complex culture. Do we have the right to expect that the historical sources of our experience, learning, concepts, values, attitudes, and subjective judgment, no matter how cleverly generalized, will prepare us to anticipate and guide the continued evolution of our culture? A deeper understanding of the performance of our forefathers and the mechanisms by which they became aware of the societal consequences of technology must help us perceive the trends within the assessment process in its policy formulation context.

All technologies mature. All growth subsides. The limits to growth are encountered by all systems. But are the impacts of technology in these later stages similar to those of the growth phases? This is a critical but largely unexplored issue of Technology Assessment. What policies are there,

what policies should be used and how, at these later stages of development? Is the demise of mature technology inevitable or is it the result of neglect and ineptitude of the management and regulatory process?

Marine telegraphy offers a unique opportunity to learn in all of the above areas. It covers a broad span of history and is still a viable industry; it was a booming growth technology that dominated international communications for sixty or more years; it is currently a mature technology which has come to grips with the limits of its growth. As a technology its impacts were widespread, yet they are sufficiently well defined and contained to yield to this analysis. Finally we have a rare opportunity to assist and build upon extensive focused historical research already several years in progress.

SECTION IV - THE STUDY PLAN

A. Focus of Proposed Research

A brief overview of the study plan appeared in Section II. The focus of the proposed research is the production of three elements, defined below:

- An Historical Assessment

  No formal comprehensive Technology Assessment on Submarine Telegraphy as an emerging technology was done in 1851, 1861, 1920, or at any other time. Nonetheless, some of the elements of an assessment appeared both formally (e.g., the British Government report of 1861, cited on page 8 above) and informally in contemporary writings, newspapers, scientific letters, etc. The emphasis will be on informed opinions of responsible parties (decisionmakers, affected parties, and public opinion leaders).

  The individuals and institutions who were the decisionmakers relevant to the development of submarine telegraphy will be identified.

  Those who were perceived (at the time) as potentially affected parties will also be identified.

  The public policy options which were perceived and discussed during the period of early development of the technology will also be identified.

N76-15939

III. INSTITUTIONALIZATION OF TECHNOLOGY ASSESSMENT

A. Some Legal, Jurisdictional, and Operational Implications of a Congressional Technology Assessment Component

Louis H. MAYO

December 1969, pp. 1-54

I - Technology Assessment: Context and Needs

Substantial attention has been given to the needs of Congress for more adequate technology assessment support. Alternative notions about the specific functions and organizational arrangement to supply this support have also been given systematic consideration. The purpose of this paper is to examine briefly, through the means of a hypothetical assessment structure, certain operational implications of a Congressional Assessment Component.

Many of the controlling or influential conditions are readily apparent. Technology assessment is a vast and pervasive function engaged in by a multiplicity of participants in both the public and private sectors. Assessing entities differ as to objectives, resources, capabilities, practices, and outputs. Such entities are usually concerned with some special aspect of the overall Policy Analysis, Project Planning, Program Implementation, Regulation, or Monitoring-Evaluation process. Some assessment entities deal with numerous technologies; others deal with only one application of a given technology; perhaps most are concerned with a narrow, specialized dimension of a given application. Few entities in our assessment structure deal with the full spectrum of social impacts of a given technological application. Even when the outputs of all existing entities in some way associated with the assessment of a particular application are combined, we cannot assume that a total assessment of all the significant social impacts have been identified and evaluated. In short, our assessment function is highly fragmented. A deficiency exists in our information management capability for assuring adequate

total impact assessments or for providing the continuity of assessment data which will identify those social impacts which need to be given attention in specific assessments. Our present assessment organization and procedures do not assure that the outputs of the multiple assessment entities constituting the assessment system for any given technological application will interact in the normal course of events (or will be consciously integrated at given intervals) so as to effectively combine assessment outputs. Assuming that such integration does periodically occur, one must still ask whether the outcome constitutes a total impact assessment of the given application. It would seem to be fairly well agreed that the Congressional Committee Hearing-Forum has not always been an adequate mechanism for integrating the relevant information into an understandable, cohesive whole.

A further factor to be noted is that numerous assessments are made by entities other than Congress which, for all practical purposes, are final. Through statutory authorization various Boards and Administrations within the Executive Branch are the loci for such assessments as are those regulatory agencies which deal with technological problems. In many instances, as with the Food and Drug Administration and the Atomic Energy Commission, a highly institutionalized assessment system for relevant applications has been developed. Where such regularized assessment systems are performing adequately, there would seem to be little need for Congressional concern other than with periodic oversight to assure continued satisfactory performance. In many areas of technological development serious deficiencies do exist, however, which would seem to require more intensive Congressional attention, at

least to the extent of assuring the establishment of assessment procedures which will provide adequate assessments, total impact or otherwise, as needed.

The great variety of assessment demands and assessment tasks in conjunction with the diversity of assessment entities make it difficult to grasp the scope of the assessment function which should be undertaken by a reinforced Legislative assessment component. Put quantitatively, what professional capability and supporting resources are required through what period of time to adequately perform a specified assessment task? Numerous variables are involved in our assessment practices:

- The character of the technology to be assessed
- The particular application to be assessed and the specific operational context in which such application is located
- The objective of the assessment: feasibility, costs, prospective social uses, possible social harms, need for further research, need for safety precautions in use, need for continuing regulations, etc.
- Limitations on resources for the assessment (time and professional talent)
- The social indicator/evaluation scheme or schemes to be employed in such evaluation

The possibility of finding precise equivalencies between the given assessment task and the time, facilities, and professional manpower required is not encouraging. Often resource constraints define the scope of the task whatever the ideal magnitude of support might be. Arbitrary constraints on time and professional support are imposed out of simple necessity to define the scope of the task and to assure its execution. One need only mention the following recent assessments in order to gain some notion of the variety of arrangements (including subject matter, objectives, and organizational structures) involved in the assessment function:

A. <u>Executive Branch:</u>

1. <u>Noise - Sound without Value.</u> Federal Council for Science and Technology (Committee on Environmental Quality), September 1968.

2. <u>Considerations Affecting Steam Power Plant Site Selection.</u> Office of Science and Technology (Energy Policy Staff), 1968.

3. <u>Environmental Impact of the Big Cypress Swamp Jetport.</u> U. S. Department of Interior, September, 1969.

4. <u>Potential Mechanization in the Flue-Cured Tobacco Industry with Emphasis on Human Resource Adjustment.</u> Department of Agriculture (Economic Research Service), September 1969.

5. <u>The Automobile and Air Pollution: A Program for Progress.</u> Department of Commerce (Commerce Technical Advisory Board, Panel on Electrically Powered Vehicles), October, 1967.

6. <u>Tomorrow's Transportation: New Systems for the Urban Future.</u> Department of Housing and Urban Development (Office of Metropolitan Development, Urban Transportation Administration), 1968.

B. <u>Legislative Branch:</u>

7. <u>The Search for a Low-Emission Vehicle.</u> U. S. Senate, Committee on Commerce (Staff Report), 91st Congress, 1st Session, 1969.

8. <u>Administration of Project Mohole by the National Science Foundation.</u> A Report to the Congress by the U. S. Comptroller-General, April 23, 1968.

C. <u>National Academy of Sciences, National Academy of Engineering, National Research Council.</u>

9. <u>Useful Applications of Earth-Oriented Satellites.</u> Summer Study on Space Applications, Division of Engineering, National Research Council, NAS-NAE, 1969.

10. <u>Drug Efficacy Study.</u> A Report to the Commissioner of Food and Drugs from the Division of Medical Sciences, National Research Council, NAS-NAE, 1969.

11. <u>Environmental Problems in South Florida.</u> A Preliminary Report of the Environmental Study Group to the Environmental Studies Board, NAS-NAE, September 16, 1969.

Our preliminary probes into the technology assessment process in the Program of Policy Studies at GWU strongly indicate that to this point we have hardly made an impression on such conceptual challenges as that of defining an Adequate Assessment or on the analytical task of relating the adequate assessment of a given application to the level of resources required. This is said with full recognition that the studies initiated by the House Committee on Science and Astronautics (the Technology Assessment Reports by the National Academy of Sciences and the National Academy of Engineering and the Report on Technical Information For Congress by the Legislative Reference Service) have greatly advanced our thinking on these and other critical assessment questions.

My comments will be directed to the following topics: 1) The positing of a hypothetical Technology Assessment Component for legislative support; 2) The posing of a number of questions relating to the operational context of this assessment component including the Organizational/Operational Framework, General Operational Problems, Access to Relevant Information, and the Utilization of Assessment Data and Analyses; and 3) Some selected comments relevant to the questions posed.

While the content of these remarks are cautionary with respect to potential operational difficulties of a legislative assessment support component, it should be understood that such comments do not reflect a negative attitude toward the need for an improved technology assessment structure. To the contrary, the purpose is to advance some questions which are likely to arise with the operations of a new assessment component, however general may be the support for its proposed

functions. That substantial reasons lend support to the need for a better structured technology assessment function seems clear. That some observers question whether such an arrangement will make an appreciable improvement in the performance of this function is, however, a point not to be lightly dismissed. Further, existing entities may be concerned over a loss of status or of function as a result of the implementation of any new effort to more adequately assess the social benefits and costs of advancing technology.

II - Congressional Technology Assessment Component: A Hypothetical Structure

The intensification of professional attention to the technology assessment function over the past few years would seem to be based on three primary assumptions: 1) That advancing science and technology should be applied in a better informed and more deliberate manner so as to maximize social benefits and minimize social costs; and 2) That the technology assessment function can be more adequately performed than is now the case with a resulting net gain in the social benefit/cost ratio of technological applications; and 3) That the Congress needs an independent technology assessment capability of its own. Hence, we need to know which technology assessment systems are performing adequately and why and which technology assessment systems are not working well and why. Several deficiencies are apparent to those who have given attention to this problem, as for example, the lack of coordination among relevant assessment mechanisms for particular applications and the inability, for this and other reasons, to perform total impact assessments of such applications. With an understanding of the more serious deficiencies, it is feasible to move to the question of what can be done to improve the adequacy of the assessment function. This basic question can be reduced further to inquiries relating to the conceptual, organizational, and operational aspects of a new mechanism or arrangement for achieving an improved assessment function.

It is evident that the range of organizational alternatives which might be employed in order to provide more effective technology assessment data to the Congress is extremely broad. Certain suggestions have been made by the recent reports on Technology Assessment of the National

Academy of Sciences and the National Academy of Engineering and by the Legislative Reference Service of the Library of Congress on Technical Information For Congress. It might also be noted that many other suggestions have been made by Committees of the Congress as well as by individuals. Eilene Galloway discusses the topic of Scientific Advice for Congress in "An Analysis of Three Proposals" which is included in the book Knowledge and Power, edited by Sanford A. Lakoff (1966). All such proposals have certain recognizable disadvantages as well as advantages. All leave considerable areas of uncertainty as to how useful such mechanisms would prove to be in actual operation. No doubt, any additional alternatives will have similar characteristics. The task, however, is to examine as thoroughly as possible beforehand the means of maximizing the adequacy of the assessment function while minimizing insofar as practicable, the legal, jurisdictional, and other operational difficulties.

In recognition of the reluctance to establish new agencies out of fear of simply adding further bureaucratic impedance to the governmental assessment circuit some observers no doubt feel that the sensible approach is to locate any additional assessment capability in an existing organization. Yet, the NAS/NAE Reports on Technology Assessment suggest that new mechanisms are needed. The NAE Report states in its Summary of Findings:

> Technology assessments on a broad range of subjects are feasible and can be expected to be useful to the decision-making processes of the Congress, when prepared by properly constituted, independent, ad hoc task forces with adequate staff support and time. (p. 3).

> A management organization, controlled by and answering to the Congress, should arrange for the preparation of technology assessments for Congressional purposes. No single, permanent organization can be envisioned that could provide adequate in-house expertise to execute assessments in all of the fields that may be required by Congress. Therefore it would be useful to contract for or to administer and organize the assessment task forces. (p. 4).

The NAS Report gives attention to several organizational alternatives. It was agreed among this panel that there should be important assessment components in both the Legislative and Executive Branches. With reference to the Congress, one alternative considered was that of a Joint Congressional Committee on Technology Assessment supported by a highly qualified staff. Another separate alternative was that of a Technology Assessment Office serving the Congress as a whole. The NAS Report states that: "The panel is not prepared to recommend a choice between a Congress-wide unit and a joint committee."

In view of the fact that possibilities for a new assessment arrangement are almost unlimited and that subsequent operational characteristics would depend to a substantial extent upon the particular arrangement selected, it is felt useful to posit a hypothetical Congressional Technology Assessment Component for purposes of this discussion. The arrangement here posited is not necessarily offered as the most desirable among the various alternatives. It has been selected for two primary reasons: 1) The basic structure is easily grasped; and 2) the interrelationships which would be involved in the operations of such a component raise a rather broad range of questions which probably merit consideration preparatory to the design of a new mechanism.

In the barest, skeletal form the Assessment Component posited consists of two elements:

1. An Office of Technology Assessment which will perform a variety of assessment tasks in support of Congressional decision making

2. A Joint Select Committee on Technology and Society which will focus attention on the general problem of the application of technological resources to social needs as well as perform consulting, advising and oversight functions in connection with the operations of the Office of Technology Assessment.

A more detailed exposition of the concept, functions, and organizational aspects of the Congressional Assessment Component are as follows:

<u>ASSUMPTION</u>: That the Congress is in need of improved informational and analytical support on legislative matters involving substantial scientific or technological components.

An assessment arrangement with the below noted characteristics is <u>posited for analytical purposes</u>, i.e., the <u>legal/political implications which may arise from the operations</u> of a Technology Assessment Component.

- -

<u>CONCEPT AND FUNCTIONS</u>:

A Congressional entity which can perform the function of assembling and analyzing data relevant to an overall evaluation of the effectiveness of the process of applying technological resources to National social goals.

An assessment service which can assure the Congress and its Committees that the full range of social impacts have (or have not) been identified and the magnitude, intensity and persistency of such effects measured re significant technological applications; and provide (if requested and appropriate) evaluations of the social desirability or undesirability of such impacts in accord with an explicit scheme or schemes of social indicators.

An assessment service which performs primarily an "integrationist" function, making maximum use of the assessment data from various existing technology assessment systems so as to provide Total Impact Assessment data to the Congress with the greatest effectiveness and economy.

An assessment service which can evaluate for the Congress the adequacy of assessment systems for existing or prospective applications, identifying deficiencies in existing "regularized" or "institutionalized" assessment systems and recommending means for correcting such deficiencies. (For example, the lack of reliable data on certain obvious social impacts or the failure to provide a forum for all affected segments of the public to advance claims or complaints re technological applications).

An assessment service which can provide the Congress with initial assessments on new or prospective applications if no regularized assessment system exists for such task and such assessment is not forthcoming from other reliable sources.

An assessment service which can advise relevant Committees of the Congress (when requested) information on segments of the public which should be represented by witnesses in the ultimate assessment forum (Congressional hearing).

An assessment service which can provide for an information service by which assessment information can be accumulated in an orderly, current, and usable fashion.

ORGANIZATION: (PRESCRIBE BY STATUTE)

1. Set out declaration of Congressional Policy (Concept and Functions as noted above).

2. Establish an Office of Technology Assessment (OTA) to carry out the desired functions.

3. Provide for a Director of the Office to be appointed by the President for an extended term (10-15 years).

4. Provide for the Director to obtain from all Departments and Agencies of the Federal Government pertinent assessment information on technological applications (primarily non-defense) which the OTA may from time to time require in the performance of its responsibilities (with exceptions minimized and noted).

5. Provide contractual authority for the OTA with respect to Project Research Support.

6. Provide for joint consultation with the National Science Foundation on Institutional Grant Support to Universities, National Laboratories, Policy Analysis Groups and similar Organizations which can provide continuing developmental support in specialized areas of technology assessment.

7. Provide for a Joint Select Committee on Technology and Society which will perform the following functions:

   a. Keep fully and currently informed on the status and prospects for the application of technological resources to national social goals.

   b. Provide a forum for the evaluation of the overall impact of technological applications on the full spectrum of social needs.

c. Encourage the use of analytical approaches and information management techniques in the assessment of technological applications which will support an overall system of social accounting.

d. Consult and advise with the Director of the Office of Technology Assessment on the policies, objectives, tasks, and assessment practices of the Office.

e. Review periodically the performance of the Office of Technology Assessment.

f. Recommend to the Committees on Government Operations the annual budgetary support for the Office of Technology Assessment, including joint programs with other offices or agencies.

g. Maintain the closest practicable liaison with the Executive Office of the President and agencies of the Executive Branch responsible for the application of technological resources to social needs.

One point merits attention before proceeding to more specific questions. While this assessment arrangement is not posited as a model to be advocated to the exclusion of others but,rather as an analytical reference, there is one conceptual thrust to this arrangement which justifies brief elaboration and strong emphasis. The rationale underlying the Joint Select Committee on Technology and Society is not that it serve merely as a link between the Congress and the Office of Technology Assessment, undertaking Congressional coordinating functions re public issues involving significant technological components, processing requests from various Committees directed to the OTA, performing as a consulting and oversight Committee for the OTA, and providing a mechanism for facilitating the OTA's information exchanges with other governmental agencies and private sector entities. The JSC would have a broader responsibility than technology assessment in the sense of identifying the impacts of given applications and evaluating the social benefit/cost ratio of such applications. This type of analytical task would be the province of OTA. The Joint Select Committee would assume the responsibility of keeping fully and currently informed on the total national potential for the application of technological resources to social needs. Technology assessment is only one aspect, however important, to this more general function. The outcome of a total impact assessment of a prospective technological application under specified conditions is, of course, essential in determining whether and how such technology is to be applied. However, this analytical task is, or should be with new technologies, only one significant phase in the process of getting the technology applied if

it does have real potential for eliminating certain social harms or for contributing to various social objectives. Put another way; the mere positing of a technology against relevant social needs is only a beginning of the process of moving such technology into an operational program. The process of technology application is a social/political action process, not just an analytical task which involves the recognition of the interaction of such elements as:

- Participants in the relevant socio/political context in which the application is to be applied
- The Perspectives and Resources of such Participants
- Influential Contextual Conditions and Trends
- Situations of Assessment (Forums) and/or Decision (Arenas)
- Alternative Strategies employed by Participants
- Alternative Outcomes of Assessment Forums or Decisional Arenas
- Probable Social Impacts of such Outcomes

It is not suggested that the JSC have any direct legislative authority with respect to the actual process of getting socially useful, available and prospective, technologies applied. It is suggested that it perform an informational integrating function and provide a forum whereby an approximate accounting can be continuously conducted on the effectiveness with which our technological resources are being applied to social goals, for example, how our national laboratories, scientific institutes and associations, the universities, R & D firms, and so forth, can best contribute their facilities and skills to social objectives.

A compelling reason for this suggestion is that a positive thrust should be given to scientific and technological enterprise which

represents one of our great national resources. The assumption of a responsibility to review and appraise the effectiveness with which we are applying such resources to pressing national social needs would fill a neglected policy function. Further, it would serve as a counterbalance to any tendency to become negatively oriented in the technology assessment function, i.e., to emphasize detriments to the neglect of the social benefits flowing from particular applications.

III - Office of Technology Assessment: Responsibilities, Powers and Operations

The following questions are focused upon the operations of the hypothetical Office of Technology Assessment although the relationships necessarily involve the posited Joint Select Committee on Technology and Society, other Committees of the Congress, the Legislative Reference Service, the General Accounting Office, the Executive Office of the President, various Departments and Agencies in the Executive Branch, the Regulatory Agencies, and private sector entities.

A. ORGANIZATIONAL/OPERATIONAL FRAMEWORK

1. Assuming the Technology Assessment Component posited, should the statutory scheme provide explicitly that the final authority for setting the assessment tasks of the OTA are to be with the Director of the OTA? Should such authority be qualified by requiring consultation with the JSC on Technology and Society at stated intervals, i.e., annually, semi-annually? Since the JSC would be representative of the entire Congress, how might the process of agenda formulation be organized?

2. What criteria of priority should be employed in selecting assessment tasks?

3. Would the acceptance of the foregoing method (A.1.) of "setting the agenda" necessarily preclude responses to assessment requests from other sources? Individual Congressmen? All Congressional Committees having jurisdiction over social problems areas or governmental activities involving significant scientific or technological components? The President (BOB, OST, etc.)? Executive Agencies, Programs, or Administrations?

4. Should the OTA be directed by statute to maintain a continuing information interaction with the OST/BOB in order to coordinate assessment efforts and maximize the productiveness of assessment activities in both the Executive and Legislative Branches? If so, how might this be accomplished?

5. Will the OTA be expected to coordinate only with OST/BOB or to maintain continuing assessment information arrangements with all executive and regulatory agencies as well as private sector entities as a means of assuring the optimum use of assessment capabilities?

6. Should provision be made for "public hearings" by the OTA? Under what circumstances might such hearings be required? For what purposes should the OTA otherwise initiate hearings? Under what conditions might hearings be initiated "on petition" and by what "interested parties"? If formal hearing authority should be provided, under what circumstances would witnesses be placed under oath? If a witness is compelled to testify, would he have the right to counsel? Should counsel be privileged to cross-examine witnesses giving evidence contrary to his client? Would testimony or communications from witnesses or correspondents with the OTA be privileged? As an alternative to OTA hearings, might the public hearing function be conducted only by the Joint Select Committee on Technology and Society?

7. In order to maintain the "independence" and "integrity" of the assessment function, what proscriptions, if any, should the Congress place on the Director and Staff of the OTA with respect to associations and relationships with other assessment entities or interested participants?

8. Will reports of the OTA have any special legal standing in civil or criminal cases against government officials or private companies responsible for the application of technologies which have resulted in alleged harm to a complainant? Will the director or members of the OTA be subject to subpoena as witnesses in such cases?

B. GENERAL OPERATIONAL PROBLEMS

1. To what extent might a skeptical attitude toward the social utility of a Congressional Assessment Component hinder the operations of OTA?

2. To what extent might the critical/cautious attitude arising from jurisdictional conflicts or additional administrative inconvenience hinder the operations of OTA?

3. What "image" should the OTA attempt to cultivate? While the basic thrust may be toward the establishment of a non-partisan, non-political entity of recognized capability and competence, in what respects must the OTA inevitably assume a "partisan" stance? Will it be an "active" or "passive" ombudsman? What type of role should it play and what "reputation" should it seek in order to maximize its usefulness in the legislative process?

4. What would be the likely implications should the OTA assess not merely technological applications per se (assuming competent and responsible administration and management) but the quality of the management of the application as well?

5. What general guidelines should be provided, and by whom, for the division of responsibility for technology assessment among OTA, the Science Policy Research Division of the Legislative Reference Service of the Library of Congress, the General Accounting Office, and particular Committees of the Congress, if any, which may wish to provide or continue with their separate assessment functions?

6. How might the OTA provide for the accommodation of ad hoc, special, "non-programmed" assessment activities? Even should the Director of OTA attempt to minimize the ad hoc obligations of the Office, how could he respond in a practical sense re:

    - Permitting OTA staff to appear as witnesses before Congressional Committees on specific bills?
    - Providing special reports on specific bills?
    - Making temporary assignments of OTA Staff Members to Committees?
    - Making temporary assignments of OTA Staff Members to Executive Agencies?

7. What type or types of Assessment Data Systems should be initiated and maintained by the OTA? Will the OTA, in general, tend to apply its resources to the task of closing deficiencies in existing institutionalized assessment data systems and in designing and initiating new data systems for prospective technological applications?

C. ACCESS TO RELEVANT INFORMATION

1. What will be the scope of the responsibility of the OTA for technology assessment? Will it have defined areas for inquiry or will it be given the broadest type of charter for inquiring into every facet of technological applications (existing and prospective) on a Total Impact Assessment basis - that is, looking at all the social interactions of a given application? This is a basic question having implications for subsequent questions.

2. Will the OTA be provided with formal authority (similar to the GAO) which is essentially co-extensive with its responsibilities or might the compulsory authority of the OTA be deliberately minimized in order to encourage the development of mutually beneficial information exchange relationships? In other words, will the strategy be to persuade, appealing to the net gains from the technology assessment function, rather than to compel?

3. What should be the nature of the authority granted the OTA by Congress so as to facilitate its access to relevant information in the Executive Branch? In the Regulatory Agencies?

4. What would be the nature of the formal authority conferred on the OTA by the Congress so as to facilitate its access to essential data in the private sector: competitive information, private/personal information such as hospital or nursing home records, etc.?

5. What would be the position of the OTA if, subsequent to the establishment of the OTA, one or more of the Committees of the Congress now having oversight responsibilities for a given technological area refused to cooperate and directed the relevant Regulatory Agency and the regulated industry entities not to cooperate (re providing relevant assessment data) with the OTA?

6. What if the Secretary of an Executive Department should take a similar position and the President, while refusing to permit the exercise of Executive Privilege in the situation, remained indifferent?

7. Assuming that in some limited circumstances the OTA should have the subpoena power or should have access to information through the direct subpoena power of Congress, what guidelines should be provided which would define such limited and justifiable circumstances so as to withstand legal challenge?

8. Should the OTA have to resort to BOB "clearance" of its information surveys with private sector entities? Should the OTA have to resort to information filed with other government agencies rather than make direct demands on private industry?

9. What will be the procedures and criteria employed for "contracting out" special assessment studies or other tasks? To what extent might it be required to do such contracting out on a competitive basis? Will contracting out (especially if the OTA should undertake to utilize a large number and variety of contractors) tend to aggravate the information assess problems with the Executive Agencies and private sector entities (imposing upon such Agencies and entities an increasingly greater burden in terms of informational requirements)? What might be done with respect to selecting topics and contractors to minimize this burden?

10. What should be the procedure and criteria for selecting organizations or institutions which might qualify for continuing "institutional grants" to carry on segments of an overall "systems approach" to technology assessment?

11. What role will "experts" or advisory committees have in OTA operations?

12. How can the OTA handle various types of "conflict of interest" problems which might not arise as a legal issue but for reason that full and candid information from a uniquely qualified individual would place him in a difficult position re his relationship with his associated organization or institution? Would the OTA activity bring up any new "conflict of interest" questions? What would likely be the attitude of the OTA re well informed people who are acting as regular consultants to various mission-oriented Government agencies?

13. Would any unique problems arise re the collection and retention of certain types of information under "for official use only" categories? Would problems be different from those which arise with the Census or with the Regulatory Agencies which do maintain the confidentiality of financial statements of the industrial groups regulated?

D. UTILIZATION OF ASSESSMENT DATA AND ANALYSES

1. If the OTA is to be primarily an assessment support activity for the Congress, will it nevertheless be assumed to be generally accountable to the Public? If some segment or participant in the "public" is dissatisfied with OTA performance, to whom can the complaint be made?

2. Which Committees will regularly receive the reports and statements of the OTA? Which Committees will receive particular reports and on what basis? Which entities of the Executive Branch? What private sector entities?

3. What will be the responsibilities of the OTA to inform relevant Committees of the Congress with respect to the Optimum Social System (effects and interactions) which should be examined when specific bills come before such Committees? This matter has special relevance to proposals involving continuing technological developments for which many of the relevant impacts have already been given attention in previous assessments?

4. Are there any types of assessment reports which will not be generally available to the Congress, the Executive Agencies, or to any segment of the public? Will the OTA direct its activities only to "non-security" problems? Will some reports be limited in distribution if "classified" material has been used but the report itself is not classified?

5. Who will be able to complain to whom in what forum and under what circumstances if the OTA undertakes to disseminate assessment data that may be considered by the complainant to affect national security or to involve private competitive information (trade secrets, etc.)?

6. Who will be able to complain to whom in what forum and under what circumstances if the petitioner asserts that relevant information (not necessarily his own) has not been taken into account in an OTA report that has been or is planned for general dissemination or to a Committee of the Congress?

7. While an OTA would not take any direct action to follow up its assessments where a recommendation is made explicitly or implicitly which is harmful or is allegedly harmful to the present or future activities of a private entity, might the OTA nevertheless be compelled (pressured) in some instances to hold rebuttal hearings for such projects?

8. What might be the possibility of instances arising in which advance notice of an assessment report (having substantial detrimental implications for a private entity or entities) would motivate the initiation of a suit for injunction to bar the release or publication of such report? How could such a suit be instituted?

9. Various problems of governmental immunity are herein suggested. What might be the liability of the OTA Director or Members of the Staff for people who have relied upon the safety of an application explicitly found beneficial by the OTA but which turns out to have serious adverse effects? Is there any precedent for personal or governmental liability of an analysis/advisory group such as OTA which has brought harm upon a private person or corporate person through arbitrary or irresponsible action?

IV - Selected Comments: Assessment Performance Criteria

It is evident that the foregoing questions do not slide into precise, discrete slots as might be indicated by the groupings used. In a sense they are all interrelated. It is therefore useless to ponder long over the proper sequence. Yet it is imperative to be concerned about certain fundamental considerations: Just what assessment functions are required to satisfy the legislative needs of the Congress? Assuming a basic organizational structure, how can such Component be employed to most effectively perform these functions? If one is inclined to feel that resistance to the performance of these functions will be serious and persistent then the Component should be armed with sufficient formal authority to assure access to relevant information. If, on the other hand, one is disposed to believe that the effectiveness of the operation depends almost entirely on the promise of mutual benefit for the various assessing entities then the strategy would be directed toward the cultivation of cooperative, non-abrasive relationships with coercive tactics reduced to a minimum. In short, the scope of assessment responsibility provided or assumed, the formal compulsory authority with which the OTA is provided, and the manner of implementing the assessment function are all closely entertwined with the "image" of OTA which will evolve.

The desire to be appreciated, even admired, may not be wholly consistent with the tasks which must be performed. Is it wise, therefore, to assume that the success of the Congressional Assessment Component will depend largely upon the disposition of the OTA to cultivate cooperative attitudes among relevant assessment entities? Might a

"hard line" assumption be just as plausible? Or should the statutory scheme provide the broadest assessment responsibility with back up formal authority in the event certain intractable situations develop, in other words, provide the widest range of options in operational procedure? Rather than wallow in the "image" question and the general operational policy to be pursued, it is probably more profitable to think of essentials and examine how certain of the questions posed might relate to characteristics such as:

- Capability of the OTA to perform assessments as comprehensive and in as much depth as Congress may desire with respect to a given technological application per se or in the context of a given social problem

- Ability of the OTA to select assessment tasks and arrange, with the assistance of the JSC, for the allocation of assessment tasks among the LRS, GAO, Executive Agencies, and private sector entities so as to most expeditiously and economically perform the desired Congressional assessment support role.

- Provision for access to the essential information sources for the assessments desired

- Provision for full representation of affected participants in the assessment process

- Capability of the OTA to manage the intricate informational networks which are indispensable for the assembly of that data upon which adequate assessments for Congressional purposes can be made

- Provision for sufficient detachment of the OTA from the political decision making process to assure independence of analysis

- Provision for the linkage from OTA to the political process which will provide effective analytical support to decisional arenas

- Provision for continuity of the assessment function

- Provision for continuing encouragement of the "professionalization" of the assessment function

It would seem advisable to restrict consideration of the questions posed in III above to a brief comment on the interrelationship of such questions to the following Assessment Performance Criteria:

- Defining and Limiting the Assessment Tasks of the OTA
- Notion of "Independence" of the Assessment Function
- Representation of Affected Participants in the Assessment Process

Discussion of the first criterion relates to such questions as:

A2, A3, A4, A5.

B4, B5, B7.

C1, C3, C8.

Discussion of the second criterion relates to such questions as:

A1, A3, A6.

B3, B6.

C1, C2.

Discussion of the third criterion relates to such questions as:

A3.

C4, C7.

a) <u>Defining and Limiting the Assessment Tasks of OTA</u>

What are the critical assessment needs of the Congress? An exhaustive answer would take some time. Clearly, Congress needs to be in better position to assess the technologically oriented proposals of the Executive Department. Congress needs continuous updating on prospective technological applications and their full social impacts. This Subcommittee itself has expressed such needs in part, but emphatically, in its Report on "Managing the Environment" (Report of the Subcommittee on Science, Research and Development to the House Committee on Science and Astronautics of June 17, 1968) wherein it was stated:

> Regardless of improvements in Executive Branch Organizations, the Congress needs an independent and comprehensive source of information and advice...(p. 36)
>
> Congress (has) a unique responsibility in obtaining objective and complete information on technological consequences...(p.2)
>
> The intent of Congress...is to avoid arbitrary regulation and to establish a fact-based, rational decision-making process which integrates all the needs of society...(p. 6)
>
> The best means of gaining long-term rational management is to generate an informational base and provide a policy to all operational programs which will cause individual decision makers to act in harmony with the entire system...(p. 29)

and finally:

> The Congress should proceed to develop an independent capability for assessing the impact of technology on the environment. (p. 8)

It is apparent that the Congress needs Special Purpose Assessments of various technological applications related to environmental management and similar support for other social problem areas as well; it also needs Total Impact Assessments which examine the full social consequences of given technological applications. These two assessment approaches are interrelated. But whatever technologies are selected for total impact assessments and whatever social problem areas are selected for the investigation of technological applications as the cause or cure of such problems, there are other types of assessment activities which must be given attention. The JSC and the OTA would need a firm grasp on the existing technology assessment structure, the major social problem areas, technological resources which are available for the advancement of social goals, technologies which are contributing to social problems, technologies which are available for abating or controlling social problems, and ways in which the assessment function can most adequately be performed. If the OTA wished to be comprehensive and systematic about this preliminary appraisal, it might proceed with some approximation to the following:

1) Systematic grouping of major technologies.

2) Systematic organization of social goals, needs or problem areas.

3) Matching technologies to relevant or potentially relevant social needs so as to facilitate the identification of existing and prospective technological applications.

4) Examination of the existing Technology Assessment Structure in order to determine:

   a. Which of the existing (or potential) technological applications has a regularized (and adequate) technology assessment system?

   b. Which of the existing (or potential) technological applications do not have an adequate technology assessment system? (Not capable of producing a total impact assessment or an optimum social sub-system for assessment with respect to a particular problem or issue)

   c. Which technological applications have a potentially adequate technology assessment system with the need being only to make adjustments in assessing entities or in the assessment process to bring them up to an adequate level of performance?

   d. Which technological applications represent both the level of effort and the characteristics of uniqueness which requires special treatment/assessment either by the new OTA structure or by special <u>ad hoc</u> assessment groups, boards, or commissions?

From this analysis the JSC/OTA will be in position to determine more accurately the level of effort required, the type of support needed, and the more promising internal and external organizational arrangements which should be developed.

This initial appraisal would provide an assessment information base which would show all of the assessing entities constituting the assessment system for major technological applications and for major social problem areas with appropriate cross-referencing. Since we cannot foresee all the possibilities under which social conditions will interact

with particular technological applications, it would seem all the more essential to develop this comprehensive assessment information system so as to provide maximum sensitivity for detecting both opportunities for the application of technological resources to social needs and early warning signals of impending detrimental impacts.

Having taken this approach, we are immediately beset with a further critical question: How can the JSC/OTA Component be utilized so as best to achieve Congressional aims with the most economical and proficient use of resources? One point upon which all tend to agree is that a new assessment component should reinforce and refine the assessment function rather than attempt to duplicate existing activities. But how can this notion be reduced to organizational and operational terms? While the OTA might be given the broadest assessment responsibility and commensurate formal authority to assure the execution of assessment functions, it should restrict its tasks to those which need to be performed but which are not now being performed. It should also develop procedures for assuring that all existing technology assessment systems are operating in an adequate manner.

A few illustrations should suffice to demonstrate how the assessment burdens of OTA can be limited to the essentials. Certain points have already been suggested. With respect to existing applications where a regularized assessment system now exists with the capability of performing adequately, the OTA would have no more than a monitoring and information integration function to assure that suitable assessment data is provided the Congress. The OTA should constantly strive to develop coordination within those highly fragmented assessment systems which provide no focal

point for the integration of the total span of social impacts so as to regularize the system for performing adequate assessments. In short, the OTA should encourage, by whatever means are available, performance of assessment tasks by other entities actually or potentially capable of doing so. The OTA should take a strong anticipatory orientation toward technology and obtain, through study contracts or grants, comprehensive assessments of such technologies, especially in cases where developing partisan interests may subsequently preclude access to relevant data or deliberately distort the issues involved. The OTA should also develop a scheme of priorities of assessment tasks which will assist in assuring that the more significant or critical matters are given attention. Both the NAS and NAE Reports on Technology Assessment attempt to provide some guidance in this connection. It is also evident from the previous discussion that assessment tasks should be located primarily in those entities best equipped to perform them. The development of such operational policies by the OTA should make its assessment responsibility more manageable.

Certain implications follow the foregoing approach. Consider, for example, that the Legislative Reference Service performs a particularly useful job for the Congress. More specifically, the Science Policy Research Division produced an excellent study on Technical Information for Congress. The list of technology assessment projects now in progress, as outlined by Mr. Jayson in these hearings on November 24, 1969, is certainly impressive. It is also to be noted that the research staff assists the Committees of Congress in identifying witnesses, preparing reports, and serving as consultants to the Committees. As was indicated by Mr. Jayson, however, the management and monitoring of a technology assessment function as he envisages the emerging need "will require a substantial commitment of funds" in order to support a vastly enlarged assessment capability. In sum it would seem that an Office of Technology Assessment would be required with new responsibilities whether attached to the Legislative Reference Service or not. In any event, the type of service now provided by the Science Policy Research Division is essential. Since this capability already exists there would be no need for an OTA to duplicate it. Further, as noted subsequently, the established practice of the Legislative Reference Service (SPRD) in responding to the requests of any Committee of the Congress may not be a procedure the OTA might deem advisable to follow. Yet, the "on call" procedure certainly appears to be a most useful one and will undoubtedly be continued by the Legislative Reference Service.

Implicit in the Report on Technical Information for Congress is the cautionary theme that technology assessment not be viewed as a simplistic process. There are endless ramifications. One which should be of concern is the necessity for and extent to which management considerations of

technological projects will or should be encompassed in the concept of assessment. The management of a technological application can make a vast difference in the resulting social benefits and costs of a project. An article in the Washington Evening Star of November 25, 1969, p.12, col. 1, illustrates this point. In connection with an investigation by the National Transportation Safety Board on "the carriage of large quantities of hazardous materials through populated areas (where) supposedly effective safety controls do not work," the Board is quoted:

> Many of the failures of safety controls are attributable to ineffective planning, design, and management of safety controls involving government and private industry.

Management considerations also suggest the activities of the General Accounting Office. While not normally thought of as a technology assessment entity, the GAO performs occasional studies which are clearly germane to technology assessment even though primarily directed to fiscal and administrative aspects of technological projects. For example, the GAO made a Report to the Congress on the "Administration of Project Mohole by the National Science Foundation" (April 23, 1968). The Annual Report 1968 of the Comptroller General (of the U.S.) states:

> Among the underlying factors which led the Congress to discontinue funding Project Mohole (a project to penetrate the mantle of the earth) was the steady escalation of the estimated cost and time to complete the project. These estimates increased from \$46.7 million to \$127.1 million and from 5 to 8½ years. The report contains an analysis of the reasons for these increases and points out that under the approach followed, the Foundation was not in a position to determine adequately that the project objectives were worth the money and resources that were necessary to attain them. Yet it was totally committed to the project.

> We suggested an alternative approach to be used by the Foundation in future major research and development projects involving totally new or exploratory concepts, calling for the projects to be conducted in a number of sequential phases. Each phase would represent a specific limited agency commitment whereby it would determine the feasibility of the project objectives, the means to attain these objectives, and whether the objectives would be worth the costs involved before a contractual commitment was made.

A recent report of the GAO was directed to an "Examination into the Effectiveness of the Construction Grant Program for Abating, Controlling, and Preventing Water Pollution" (Federal Water Pollution Control Administration, Department of Interior)(November 3, 1969). This Report states: (p.3)

> RECOMMENDATIONS OR SUGGESTIONS
>
> GAO is recommending that the Secretary of the Interior require that the States, in establishing priorities for the construction of waste treatment facilities, and FWPCA, in approving grants for such construction, give consideration to (1) the benefits to be derived from the construction of the facilities and (2) the actions taken, or planned to be taken, by other polluters of the waterways.
>
> FWPCA should consider utilizing systems analysis techniques in the planning for and implementation of water pollution control programs. FWPCA should consider also the practicability of providing, through its storage and retrieval of data (STORET) system (see p. 96), data needed by the States in:
>
> --determining their water pollution control requirements,
>
> --identifying alternatives available to solve water pollution problems,
>
> --formulating water pollution control plans, and
>
> --establishing implementation schedules and priorities for the construction of waste treatment facilities.

Another report of the GAO relating to the operations of a Agriculture Research Service of the Department of Agriculture illustrates how GAO functions involve not only the mechanisms and processes of assessment but also the potential for conflict-of-interest situations to arise in the use of private consultants. (Washington Post, Nov. 17, 1969, p. A2, col. 1.). While most GAO investigations relating to technology assessment pertain to completed or existing programs, some are anticipatory in character such as the special study made of some of the legal, competitive, consumer service, and other probable implications of the sale of AEC gaseous diffusion plants to private owners. A further example is the classified evaluation made to the Joint Committee on Atomic Energy of the Nike X/Sentinel anti-ballistic missile system in terms of economy, efficiency, and effectiveness.

The GAO has not developed a special capability for technology assessment nor is its professional staff broadly representative of professional skills in comparison, for example, with the Legislative Reference Service. However, the GAO's long experience in the appraisal/evaluative function, its movement toward enlarging its skill base so as to take into account a broader spectrum of social costs and benefits, and its increasing emphasis on the systems approach to major public projects are definitely compatible with a more comprehensive technology assessment function. Even the existing fiscal and management analysis capability of GAO would provide indispensable support to an OTA in taking a comprehensive view of given applications.

Yet, however substantial the services now performed by the LRS and the GAO in technology assessment, neither is organized presently to perform the types of functions that a Congressional Component such as that posited herein could perform. Neither is really a technology assessment manager in a comprehensive sense. The bolstering up of either of these organizations would, in effect, require that a new organizational entity be established. The question then becomes whether there is promise of greater net benefit from the grafting of the expanded technology assessment function onto one of the existing organizations or by establishing a separate entity. The latter approach may add somewhat to the complexity of the organizational structure, but it would provide visibility for the assessment function which would not likely emerge if such function is subsumed in the existing LRS or GAO. Further, a new organizational entity would provide the conditions for the unique tasks with which OTA would be charged. For example, it would not be expected to serve a "mass of masters" as does the Legislative Reference Service. To put the matter differently, if the Science Policy Research Division were given the amplified assessment job, would it be able to meet its "on call" obligations while at the same time performing the information management tasks which will be required of the OTA? No doubt the GAO could also develop a comprehensive assessment capability, but would not this effort inevitably be subordinated to traditional GAO fiscal and management functions? What the Congress would seem to need and the JSC/OTA would provide is both the management apparatus and the "feel" of being in control of the situation. This latter element of establishing confidence in our understanding and control of the movement of technological development is perhaps the most significant objective of all. In brief, the Congressional Technology Assessment Component posited herein would fully utilize the assessment capabilities of the LRS and the GAO and, in so doing, provide for an effective allocation of assessment tasks.

A further massive allocation of assessment responsibility (which will facilitate the performance of the JSC/OTA component) can be made to the Executive Branch Departments, Administrations, and Programs which are deeply involved with technological applications. One of the primary tasks of the OTA will be to assure comprehensive total impact assessments of given applications, as well as special purpose assessments for particular social problems. The most logical loci for total impact assessments are those agencies having primary authority over relevant technological applications such as DOT in transportation technology. Here is where the basic data relating to technological applications are or should be assembled, analyzed, and reported. Apparently, DOT does not yet have this data management system, but surely it is the locus for total impact assessments of transportation projects, not the OTA. The recent Report on "Transportation Information" to the Committee on Appropriations, U.S. House of Representatives by the Secretary of Transportation of May 1969 states:

> Good decisions depend on careful analysis of pertinent information, yet decisions involving billions of dollars in transportation expenditures are frequently based on inadequate information. Without adequate information, the chances of costly errors in these decisions are greatly increased. (p.vii)
>
> Present transportation information is characterized by significant gaps, fragmentation and incompatibilities. It is not possible to examine the transportation system as a whole or in terms of its related parts. The information problem is so great that considerable efforts will be required to bring about needed improvements in transportation information. (p.vii)
>
> The magnitude of expenditures involved in many decisions on transportation items is so great that even relatively small savings - resulting from the information program - will in large in absolute terms. These savings will pay for the cost of the information program many times over (p.xi)
>
> Measures of the performance of the transportation system (in aspects besides safety) do not exist. There has been recognition recently of the need for national social indicators to parallel the long-established economic indicators. Indicators of the performance of the transportation system are a most important element in a general set of social indicators (p.127)

The foregoing relates only to one major technological application area. It demonstrates the truly staggering proportions of the information management task. It is not only undesirable that the OTA assume this entire task but would appear wholly infeasible for it to do so. Assessments made by the Executive agencies might to some extent be discounted by the ingrained skepticism of the Congress. But it would be the task of the OTA to evaluate such assessments. The implementation of the operation of the JSC/OTA component may require the reorganization of the information/assessment structure of the Executive agencies to a far greater extent than is herein posited for the Congressional Assessment Component. It would seem that these two assessment developments must proceed concurrently and in coordination. Being highly interdependent, the Congressional and Executive Components must closely mesh if the overall assessment function is to be effective. There must be a high degree of concurrence on what data is sought, means of identifying such data if existing, and means of specifying data which needs to be generated.

A real difficulty exists, however, in connection with making total impact assessments of many, perhaps most, technological applications. The formal authority for operations of those government agencies which are the most likely candidates for a total impact assessment responsibility re a particular application or applications is not necessarily co-extensive with either the full scope of effects of the application nor with the totality of aspects of the social problem context. As has been pointed out, fragmentation of the assessment function is basically a reflection of assessment entities with different authority, objectives, and capabilities. Hence, each might reasonably ask why it should accept responsibility for a total impact assessment. The Highway/Motor

Freight Carrier application and the Aircraft Noise Problem are excellent examples of this division of formal authority and assessment responsibility. This is not only evident as in the fragmentation of authority in the Federal government but also as between the Federal, State, and Local levels of authority. Since operational programs with specified and usually narrow authority constitute a substantial segment of the assessment entities in most technology assessment systems having to do with major applications, the crucial problem of the OTA will be to integrate the outputs of such entities into a Total Impact Assessment.

In view of the need for most the the assessment burden, particularly with respect to governmentally sponsored technology, to be performed by Executive Branch entities, will not the effective functioning of the Congressional Technology Assessment Component depend upon a viable focal counterpart in the Executive Branch? Highly pertinent to this point is an article on "Presidential Staffing in the Sixties and Seventies," by William D. Carey (Public Administration Review, September/October 1969, at 450), who has long experience in Bureau of the Budget affairs. After noting that "The modern President must cope with shortened decision intervals and reaction times, and his responses to domestic and foreign challenges must be immediate and certain," Mr. Carey states flatly: "The Presidency is weak in policy analysis" and follows up this discussion by pointing to a "second flaw" in these terms:

> In an age noted for advanced theory and technology in organizing and applying information, the presidency has no information system whatsoever. (p. 452)

He further states:

> It is hard to see how the presidency can grip the policy dilemmas of the 70's with its present shaky staff structure. There are limits to what can be asked of the Bureau of the Budget, which is staffed at the level it reached 20 years ago. The Council of Economic Advisors limps along with barely a score of professionals, while the Office of Science and Technology with some 35 employees cannot even begin to reshape national science goals. These units, together with the immediate White House staff, constitute the troops. (p. 457)

The NAS Report strongly emphasizes the need for an Executive Assessment Component as a focal point of Executive Department Assessments and as the locus of a comprehensive information system. One might question whether Congress should rely solely upon this data source. The NAS Report does suggest that the Congress might wish to establish an assessment data system of its own. It would seem that the JSC/OTA component would feel considerably more confident if it had control of its own overall data source, although such system should make use of OST assessment data instead of duplicating the data generation process. In any event, the OTA, even if agreeing with the impacts identified by the Executive Component re a given technological application, may have quite different notions as to the social significance of such impacts, if measured against social indicators reflecting a Congressional rather than an Executive perspective. A total Impact assessment capability in the OST, for example, which would undertake to integrate the outputs of Executive agencies and departments and private sector entities into total impact assessments would surely lend tremendous assistance to the OTA. If such capability is not established on a regularized basis then there would seem to be no alternative for the OTA than to develop direct communications links with all relevant Executive Departments and Agencies.

b) Notion of "Independence of the Assessment Function

Considerable attention has been given to an assumed relati .ship between the credibility of the assessment process and the establishment of appropriate conditions for detached, non-partisan performance of the assessment function. This relationship has several facets and has been expressed in different ways. In this presentation it would have specific reference to the posited Office of Technology Assessment. The Report of the National Academy of Engineering on Technology Assessment is relevant to this matter:

> Technology assessments should be produced in an environment free from political influence or predetermined bias. It can be inferred from the pilot studies that the selection of a preferred course of action, among alternative strategies derived from the assessment, is not a suitable task for the technology assessment group. This function should remain the prerogative of the legislator after he has been provided with the bases for the application of his judgment. (p.3)
>
> Members of a technology assessment task force should be chosen for their expertise but not as representatives of affected parties or special interests.(p. 4)
>
> Experience shows that the task force members possessing a wide range of personal interests have been able to focus on the public interest and to set aside the biases of the organizations with which they are associated. (p.4))

The NAS Report on Technology Assessment makes a number of observations and suggestions with respect to this matter:

> (A) central deficiency of existing mechanisms for assessment is that they fail to separate promotion or protection from evaluation, and thereby compromise both their integrity and their credibility. To overcome that deficiency, any new mechanism we propose must be carefully insulated from direct policy making powers and responsibilities. (p. 80)

The Report also states that granting a power to "censor all technological developments" could not be insulated from external political pressures and further:

> (E)ntrusting such sweeping powers to a new assessment entity would rob it of any special claim to objectivity and would render its judgments at least as suspect as those of any other regulatory body. (p. 81)

More directly to the point, the Report states:

> Any new assessment entity we propose, therefore, should be empowered to study and to recommend but not to act. It must be able to evaluate but neither to sponsor nor to prevent. We confront, however, something of a paradox, for though we wish to assure the neutrality of the new mechanism, we wish also to assure that it be influential. The panel has no thought of urging the creation of another organization simply to add one more voice to the many that already cry out for change. Thus, while it must itself seek to be apolitical, any new assessment mechanism must be located close to the centers of power in the political process; given the vast powers of the contending interest that will surround it, any organization less centrally situated would have no realistic hope of materially influencing public policy. (p. 82)
>
> The most we can hope for in creating a new mechanism for technology assessment is to introduce a greater degree of objectivity into the process and to inject a body of criteria and assumptions that reflect a wider set of interests and values than do the specialized organizations currently engaged in fragmented assessment activities. (p. 83.)

The thrust of the foregoing extracts from the NAS and NAE Reports seem clear enough, although some of us might wish to substitute other terms such as "non-partisan" for "neutral" and the concept of "adequacy of assessment" for "objectivity of assessment." Perhaps the critical issue in addressing the proposed OTA function would be the reference to the "paradox" confronted in attempting to design an apolitical mechanism which will exert an appreciable degree of influence on the political process. What we must do, it would seem, is to brush away the "logical impasse" and get on with the job of designing the most

creditable assessment function feasible for the express purpose of introducing useful and reliable assessment data into the legislative process. This does not eliminate the inherent difficulty, but it does present a socially desirable task rather than a verbal "hang-up."

The GAO statutory scheme and practices are instructive in this connection. The Comptroller General is an "agent of the Congress." Among other things, the GAO has the authority and the responsibility to "make such investigations of revenue, appropriations, or expenditures as ordered by either House of Congress or any Committee having jurisdiction over such matters." (31 USCA 53(b)). The Comptroller General also has the responsibility to report to the Congress, and if requested, to the President, including "recommendations concerning the legislation he may deem necessary to facilitate the prompt and accurate rendition and settlement of accounts and concerning such other matters relating to the receipt, disbursement, and application of public funds as he may think advisable." (31 USCA 53 (a)). One might contend that such matters are more susceptible to consensual agreement, that is, less controversial, than the subject matter of technological assessments, i.e., the identification and evaluation of the full range of social values affected. But certain investigations and reports of the GAO are clearly politically sensitive. Nevertheless, it is my impression that the GAO generally enjoys a reputation as a highly competent, reliable, and non-partisan activity. The high respect status enjoyed by the GAO is perhaps largely attributable to an intelligent use of discretion by the Comptroller General and his associates as to what types of investigations and reports the GAO capability can be

applied usefully as distinguished from those which are so highly politicized as not be be amenable to analytical treatment. It is also my impression that the National Transportation Safety Board of the Executive Branch (DOT) is gradually building a similar reputation for its impartial, delibarate process of accident investigation.

Measured against the criteria offered by the NAS/NAE Reports and the experience of the General Accounting Office, how might one evaluate the prospects for the effective functioning of the Congressional Assessment Component posited herein?

Would not the establishment of both a Joint Select Committee on Technology and Society and an Office of Technology Assessment provide an organizational focus of attention commensurate with the significance of advancing technology to social problem areas? This would provide an instrument for taking a total systems view of the interaction of technology with relevant participants, institutions, and values.

The Office of Technology Assessment is envisioned as an assessment support group directly responsible to the Congress through the Joint Congressional Committee on Technology and Society. It would be an entity separately identifiable from the staff of the Joint Committee. Would not such an arrangement provide organizationally for independence of function and operations by the OTA while at the same time providing for a direct link to the legislative process through the Joint Select Committee? In view of the enormity of the task that will be required if any substantial increment of assistance is to be provided the Congress on technology assessment, it would seem abundantly clear that an Office of Technology Assessment is needed in addition to the Joint Select Committee staff.

As noted, the NAS Report warns against the assumption of too extensive a power over technological development and attempts to clarify the conceptual conflict between the maintenance of a non-partisan stance and the exercise of influence on decision making. But it would appear that at a certain point on the curve the two characteristics can be mutually supportable. Once an entity has gained a reputation for usefulness and credibility, meaning that it is "listened to," it is also likely to be strengthened in its "independence" since the preservation of conditions for a detached analysis is recognized as serving the needs of all concerned. Again, it would appear that the GAO has come close to approximating this status. But the achievement of this status is not simply a matter of organization. Other variables are evident First, the recognition by the Congress of the significance of our technological resources and the disposition to assure their effective utilization is essential. The OTA will have to be given broad authority similar in scope to that of the GAO in order to establish the importance of the OTA function and to assure access to relevant assessment data. Provision must be made for a staff which will provide an assessment capability of the highest order. A strategy of implementation must be designed which will gain the support of relevant assessing entities, including opportunity for general public participation in the assessment function. Ultimately, independence of operations, as well as influence on decisions, will be achieved through performance and through public confidence resulting from professionalization of the assessment function.

One mark of independence is the degree of control over the activities of an entity. Surely, the broader the range of controllers, in the sense that an official or organization is in position to request or demand the performance of certain tasks, the less control the entity has. If all Congressmen or even all Committees can call upon the OTA for assessment tasks, then the independence of the OTA will clearly become diluted. This does not mean that the OTA would operate entirely outside the perimeter of Congressional needs. Such needs can be expressed through the JSC, and periodic consultation can keep the OTA currently apprised of Congressional needs. Nor would occasional ad hoc requests of Congressional Committees through the JSC necessarily be excluded. But the point is that the Director of the OTA should have the final determination of what assessment activities the OTA can usefully undertake. Consultation with the JSC, as well as the requests for assessment assistance which will inevitably be directed to the OTA, will surely keep the latter finely attuned to the types of assessment tasks which the Congress and other agencies consider of importance. The Director will surely wish to be responsive to the Congress, but he must be in position to make a determination on the basis of an informed judment as to what the more urgent existing and prospective needs are, and he should have the statutory authority to do so. It would seem that a workable accommodation can be made. GAO experience is to some degree relevant here. The Comptroller General is not obliged by statute to respond to every individual Congressional request but apparently undertakes to do so within the limits of GAO capability.

Two processes are always working in conjunction: the political, partisan, adversarial system on the one hand and the non-partisan, detached, professional, "respected source of information and analysis" approach on the other. The first is nurtured by partisan interests, by differences in attitudes toward priorities in social values, and by uncertainties as to facts, predictions, and social consequences. The second has its source of strength in the need for a trusted source of information and in the need for the positing and explication of public interest-oriented standards of judgment against which partisan claims and demands can be tested and judged. In the assessment component posited, the JSC provides the link to the political decision process while the OTA provides the second, informational-analytical need.

The critical problem is to develop an OTA that is useful and credible. The danger of the OTA's abusing its powers appears remote. When an entity becomes influential, it simply means that it has an appreciable effect on immediate or ultimate determinations of legal rights and duties or of the allocation of resources, i.e., benefits and costs. Hence, those who are or may be affected will demand having either an input to the assessment forum or the opportunity to challenge assessment outcomes which may be contrary to their interests Such provision must be made, of course. But in addition, it would seem a reasonable assumption that the wide diversity of interests represented in the Congress would effectively curb any undue exercise of influence over political decisions by the OTA. Furthermore, whether obliged by statute or not, the OTA would surely follow the information access and dissemination policy as set forth in the Freedom of Information Act (5 USCA 552).
This practice would not only be desirable in order for the OTA to

develop effective working relationships but for the purpose of establishing its credibility with relevant governmental and private sector entities. Such informational practices themselves are effective constraints on arbitrary or thoughtless action.

c. Representation of Affected Participants in the Assessment Process

The concept of total impact assessment of technological applications requires that the full spectrum of social interactions be explored by the OTA. The staff of the OTA, representing all relevant professional and disciplinary skills, will be in position to identify most likely impacts of an application. However, this internal process of analysis may not in many instances provide a fully confident basis for assessment even though one purpose of the OTA in using assessment project contractors, institutional grantees, advisory groups or special *ad hoc* commissions will be to assist the OTA in identifying the social impacts of given applications or of alternative technological projects and making determinations on the magnitude, intensity, and persistency of such impacts. In addition to the identification of effects, however, there is the further dimension of assessment which will arise in connection with some assessment tasks, i.e., the evaluation of the social desirability or undesirability of such impacts. Certain segments of the public may well view such impacts as benefits or threats in quite different ways. Every application involves both benefits and costs, but it does not follow that those segments of the public which share the benefits necessarily coincide with those segments of the public which must bear the costs. It is often difficult to gain full appreciation of these considerations without direct inputs from such affected *publics*. Perhaps in a majority of situations those segments of the public affected will have an organizational channel for expressing their views which will come to the attention of the OTA.

It is likely, however, and especially with prospective applications, that segments of the public will be affected which are not represented by an organized interest group or such group might not have perceived the implications of the application. Hence, the question arises as to how the OTA is to be assured of data on the full span of actual or probable social consequences.

Some sort of modified public hearing procedure which would invite relevant informational inputs during the assessment process need not be incompatible with the concept of a professional, impartial, public interest-oriented entity such as the OTA. A question does arise as to the extent such procedure should be formalized. Many entities shy away from the judicialization of what are essentially assessment determinations, feeling that the rigid procedures characterizing the formal adjudicatory adversarial process deter rather than facilitate access to relevant data. The view is sometimes expressed that the adversary process is not suitable to the temperament of those whose professional modes of inquiry tend toward the dispassionate search for "truth" rather than to the extraction of the "facts" through partisan, sometimes compulsory questioning. One must face the reality of those assessment situations, however, where the assessment concerns existing applications as contrasted with prospective projects. In these situations, the assessment outcome will inevitably affect legal rights and duties or the allocation of power, political or economic. This situation invites controversy and demands to assert partisan claims.

It would not seem advisable for the OTA to be made subject to the Administrative Procedure Act or that it pursue hearing procedures which would require the imposition of similar processes. The Congress is, of course, specifically excluded from the definition of "agency" provided in the APA. Further, the OTA would not have any "rule-making" or "adjudicatory" functions. In such hearings under the APA "A party is entitled to present his case or defense by oral or documentary evidence, to submit rebuttal evidence, and to conduct such cross-examination as may be required for a full and true disclosure of the facts." (S.556 (d)). Possibly relevant as a "policy" to follow in OTA assessment processes, however, is the provision in Section 556 (e) that "When an agency decision rests on official notice of a material fact not appearing in the evidence in the record, a party is entitled, on timely request, to an opportunity to show to the contrary." Yet, even the APA provides in the same Section that "Any oral or documentary evidence may be received, but the agency as a matter of policy shall provide for the exclusion of irrelevant, immaterial, or unduly repetitious evidence."

Probably something is to be learned from the procedures and practices of the National Transportation Safety Board in connection with "public hearings." The Board is an unusual type of assessment entity, the Department of Transportation Act specifically stating that in the exercise of its functions the Board is charged with a continuing review of the safety situation with respect to all modes of transportation. (Public Law 89-670, Sect. 5). The Act further states that the Board in the exercise of its function

powers, and duties shall be "...independent of the Secretary and other offices and officers of the Department." Section 5 (b) of the Act prescribes that the Board shall have responsibility for determining cause or probable cause and reporting the facts, conditions, and circumstances of accidents investigated under authority transferred to the Secretary of Transportation. Reports and recommendations of the Board, as well as special studies, must be made public. The Board is concerned with the fullest possible information. It is not concerned with authoritative determinations of placing fault or assessing legal liability. Its findings are not admissible in court. In order to obtain the most candid and uninhibited evidence feasible it is my understanding that adversarial procedures have been discouraged.

This operation raises an extremely interesting and critical question, however, relating to the status of an independent, non-partisan entity rendering assessment decisions which may ultimately have an influence on the allocation of benefits and costs in the political process or in the determination of rights and duties in the legal process. The NTSB is responsible for establishing the probable cause of accidents and this finding is directly related to fault and liability. In accident investigations the accident has occurred. Liability for certain parties and remedies for others potentially exist. The Board's recommendations have been generally accepted; thus its assessments substantially influence official decisions. Hence, various participants have a stake in its findings or may feel they do. This encourages a partisan approach which may inhibit full disclosure of facts. In such circumstances, it should be expected that partisan interests will demand to be heard.

But the Board has also employed so-called "public hearings" to evaluate means of solving problems. This is more or less equivalent to the assessment of a prospective technological application rather than an existing one. On October 31, 1969, "The National Transportation Safety Board...announced that more than 18 aviation organizations and government agencies (would) testify during the Safety Board's public hearing beginning November 4th seeking to find ways and means to define and correct the national aviation problem of midair collisions." (SB 69-88). Rather than following the somewhat formal proceedings of accident investigations, the Board set forth the rules to be followed, namely that the hearings would be a "seminar-type proceeding" and that "only Board Members will question witnesses." This procedure would seem to fit more closely Section 5 (d)(2) of the Transportation Act providing for "special studies" than to Section 5 (d)(4) of the Act pertaining to "accident investigations." Yet even the initiation of the latter is limited to those the Board "deems necessary and appropriate." But the point of interest is that by structuring a hearing in this manner the NTSB provided a means of assembling relevant data from affected participants without being burdened by the legal apparatus of a formal hearing. Subsequently, of course, should a recommendation of the NTSB be implemented by the FAA, then a rule making proceeding would be initiated in accord with the APA. Does this suggest that the OTA should restrict its "public hearings" to a similar essentially informal procedure and avoid efforts to judicialize the information gathering function? This approach would accommodate a modified adversarial system enabling relevant partisan interests to register their views on the technological application involved. It would

avoid most of the inquiries raised in Question A6 in Part III, although it would not eliminate the situation implicit in Question C7, i.e., data needed from a non-cooperative private sector entity. The experience of the National Commission on Product Safety (Joint Resolution 33, 90th Congress, November 20, 1967, Public Law 90-146) should be reviewed in this connection. The Commission was authorized to hold public hearings, to require private participants to submit reports and answer surveys, to administer oaths, and "to require by subpeona the attendance and testimony of witnesses and the production of all documentary evidence relating to the execution of its duties," (Sec. 3 (a), 81 Stat. 467). Several public hearings have been conducted by the Commission which apparently have been instrumental in securing official or voluntary action on behalf of consumer protection. ("Progress Report on Results of Commission Work," National Commission on Product Safety, November 18, 1969).

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III. INSTITUTIONALIZATION OF TECHNOLOGY ASSESSMENT

B. Some Implications of the Technology Assessment Function for the Effective Public Decision Making Process

Louis H. MAYO

May 1971, pp. 16-22

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IV - Technology Assessment: Some Illustrative Effects

Some of the probable or possible results of technology assessment can be illustrated by reference to the phases of the Policy Formulation and Program Implementation Process. These projections should be considered as hypotheses to be tested rather than predictions.

Problem Perception

- Development of a systematic Early Alert Sensing Function for:
    - Seeking out incipient crisis situations or social problem areas and matching, on a provisional basis, the means of preventing or of otherwise coping with such conditions
    - Seeking out promising opportunities to apply resources, technological or otherwise, to the achievement of desired social goals
    - Identifying prospective implications of proposed new technological applications

Problem Definition and Formulation of the Problem Context

- Continuously improving capability to apply "contextual thinking" to social problem analysis, as for example:

  Skills and techniques (including systematized reference materials such as comprehensive lists of effects related to social problem contexts) applicable to the task of identifying affected participants and value-institutional processes with respect to particular technological applications and the nature of such effects (planned or derivative; direct or indirect; immediate or remote; inevitable, probable, or possible; etc.).

- Greater sensitivity to "process thinking" with respect to technological applications, as for example, in terms of the effects which will occur during the Initiation, Implementation, and Operational Stages or in the phases of the Policy Formulation and Program Implementation Process.

- Improved capability to perform "Quick Response" preliminary assessments (after brief inspection of the relevant social problem context involved with a given technological application) which will provide rough policy guides without serious risk of ignoring significant implications

Information Assembly and Management

- Assuming the development of structured data management systems in the major mission-oriented agencies such as DOT and the development of an effective capability through the NEPA of 1969, Section 102(2)(C) experience to utilize ad hoc and informal, semi-structured assessment data "networks" within and between various levels of government, the tendency of individual agencies to spin off into autonomous orbits can be partially counteracted. Such assessment data networks will also assist in overcoming organizational deficiencies which hinder total social impact assessments of major technological applications.

- The more comprehensive and "in-depth" assessments become, the more aware various participants will become of the disclosure and use of information which may be considered harmful, i.e., claims of unjustified exposure of private competitive data or claims of invasion of individual or institutional privacy. Continuing attention will necessarily be given to control over access to data banks and to the dissemination of assessment outcomes.

- The rapidly growing information on assessment outcomes and assessment methodologies will require the initiation of a Reporter System which will systematize assessment experience in such manner as to make such data and methodologies applied available to the "assessment community" in readily usable form. This will gradually lead to regularization of the Technology Assessment Function and to "professionalization" of assessment skills. Failure to initiate such a Reporter System will likely result in stifling assessment methodology development.

Invention and Development of Alternative Means
(i.e., Resource Configurations [technological or otherwise], Statutory Schemes, Social Action Program Organization and Procedures)

- There will be an identifiable shift in emphasis from narrow issue, rule-oriented, programmed thinking to contextual, problem-oriented, alternative thinking as more adequate methodologies are developed for performance of the assessment function.

- One of the most significant effects of applying the contextual approach to Technology Assessment will be a gradual shift from "one-factor-fix" thinking (legal, economic, or technological) to "problem context" and Initiation-Implementation-Operations Process thinking. The analytical implication of this shift will be, for example, that with respect to proposals for new technological applications, the relevant assessment policy makers will consider means in terms of the Total Technological configuration (the combination of facilitating and supporting resources through time: legal, political, economic, social, etc.) rather than in terms of the technology *per se*.

- Excessive emphasis on socio-political constraints in particular assessments may, on occasion, inhibit technological initiative and innovation. Overall, however, assessment activities will create an increasing number of opportunities for innovative technologies to be applied in combination with other resource/means in order to alleviate existing social dislocations or to achieve desired social goals.

- The continuing development of the Technology Assessment Function in the various agencies of the Federal Executive, the Regulatory agencies, and in the Congress, as well as in entities at the State and local levels, will gradually bring about a regularized system of hearings or other mechanisms by which orderly inputs can be made by all community participants affected by or who might be affected by a new technological project. In addition to this "adversarial" input to the assessment function, an increasing number of "inclusive assessment outcomes" should be available from university policy analysis groups and other entities having no partisan stake in the assessment other than its adequacy.

Evaluation, Selection and Recommendation of Means

- Assessment methodological concepts and skills will provide more reliable (adequate) outcomes. Analytical skill levels will improve appreciably with respect to:

  - Problem perception and formulation

  - Organization of assessment data

  - Development of Alternative Configurations (Means, technological or otherwise) for

attaining a specified social objective or set of objectives.

- Projection of alternative future social environments reflecting all major value-institutional processes.

- Development of more useful models of individual and organizational behavior for application in the contextual/process approach to assessment.

- Simulation of changing social process/environment through time, including the interrelationship of conditions and trends.

- Both complex and simplistic assessment methodologies will be developed within the next few years, the former to accommodate comprehensive, inclusive, in-depth efforts and the latter for preliminary assessment testing or for "quick response" outcomes for urgent policy decisions.

- One of the most difficult assessment tasks will continue to be the conversion of effects into measurable social impacts. Reference NEPA of 1969, Section 102(2)(B).

- The necessity to introduce certain social value schemes into the assessment process in order to translate effects into measurable social impacts will require that much greater attention be given to alternative concepts and techniques of designing social value schemes as empirical inputs into the assessment process. This required assessment input can also be viewed and posited as alternative concepts of Social Justice, i.e., alternative ways of distributing social costs and benefits (including resource allocations and the assignment of legal rights and duties) among affected participants.

- As a general proposition it is likely that Technology Assessment as a regularized function will gain more rapid acceptance and application in the Executive Agencies and Departments than in the Congress. It is only sensible for the mission-oriented agencies, for example, to make use of inclusive, non-partisan assessments to identify objections and sources of opposition to new proposals in order to correct the configuration of the proposed project or otherwise minimize difficulties with the development of socially useful technologies. However, we shall no doubt see various participants in both the Public and Private sectors apply such comprehensive, inclusive assessments as a technique for more sophisticated advocacy of partisan positions.

- As the Technology Assessment Function develops, mission-oriented agencies will continue to be caught in a difficult position as to their assessment responsibilities. They are designed to promote research into and the development of technologies which presumably advance the public interest. But this general objective often involves an inner contradiction. The mission agency cannot act as freely partisan as many participants who might be affected by a new application. On the other hand, it may consider that its primary role is to adapt technology to social uses as it sees the problem rather than to attempt to be an impartial participant in the research and development process. The latter is the role of non-partisan, inclusive-oriented analysis groups such as university programs. Hence, the mission agencies will continue to be confronted with this eternal dilemma between promotion of its cognizant technology <u>per se</u> and development of such technology in terms of a supposedly general public interest. Regulatory agencies, on the other hand, would seem to have a clear mandate to make inclusive contextual assessments rather than to prefer the development of its regulated technological applications over other equally desirable social interests.

<u>Formal Prescription of a New Statutory Scheme And/or Authorization of a New Social Action Program</u>

- The decision to approve or disapprove technological projects can be expected to depend, in many instances, upon assessment outcomes. Such outcomes, especially those based upon an <u>inclusive</u> approach, if persuasively documented so as to show a clear net social gain or a clear net social loss with respect to a given project could be decisive. Assessment outcomes will also be utilized in making determinations as to whether a greater social benefit will result from the allocation of resources to one social problem context rather than another.

- Technology assessments will probably be influential in shaping the specific provisions of new statutory schemes authorizing public programs in that the assessment of alternative implementing means (as to organization, mode of operations, regulatory schemes, etc.) will disclose that certain implementing arrangements offer a greater net social gain. Assessment outcomes will also assist in the development of more adequate statutory standards, i.e., standards/criteria which are clearly relevant to the social objective sought, which are adaptable to the operations

under scrutiny, which are "measurable" for decisional purposes, and which readily provide for detection re compliance.

Application of New Statutory Scheme and/or Implementation and Operation of New Social Action Program

- Administrators, managers and operators of programs and projects which have been designed and implemented with the assistance of adequate assessments will be increasingly cognizant of the full scope of effects of the program's operations and will therefore be in position to maximize the social benefits and minimize the social costs to suppliers, users, and other participants affected.

- An adequate assessment function will lend useful support to all agencies (Federal, State and local levels) having a regulatory or enforcement function by providing reliable data for matching appropriate offical action with relevant social problem contexts.

Appraisal of the Effects of the Application of the New Statutory Scheme or of the Operations of the New Social Action Program

- Anticipatory technology assessments will inevitably lead to post-implementation appraisals of new technological applications and public programs involving significant technological components in order to determine if the degree to which application/operation produces effects consistent with those projected; such application/operational appraisals will also evaluate the effects of such programs for their consistency with the achievement of national policy goals in related areas of public interest.

- This amplified evaluative function will place continuing and persistent pressure on all entities (Public and Private) required for the assessment, implementation and operation of public programs to coordinate their activities so as to maximize social benefits and minimize social costs. This pressure will serve to counter the natural, inevitable, tendency of individual entities to maintain their activities as an autonomous "closed system" for purposes of jurisdictional sovereignty and bureaucratic survival.

- One significant resultant of the regularized Technology Assessment Function will be the development of alternative and increasingly refined concepts of what constitutes an "adequate assessment" in various patterns of social problem/technological application contexts.

Modification or Termination of the Statutory Scheme or the Social Action Program as Outcome of Continuing Monitoring and Appraisal

- When appraisal subsequent to program implementation and operations discloses the desirability for abrupt or premature termination, such result may mean that the original anticipatory assessment was inadequate or in some manner faulty or that conditions which existed and were appropriately projected have, for unforeseen reasons, changed substantially. In any event, continued attention to the assessment function will disclose that continuing appraisal is as indispensable to the overall Technology Assessment Function as anticipatory assessments.

- The essential point with respect to the relationship of continuing appraisal to program modification is that an increasingly greater degree of control can be maintained over the relationship between program output (performance) and the social goals the program was designed to promote. Put otherwise, the overall Technology Assessment Function, which includes consideration of all phases of the Policy Formulation and Program Implementation Process, is the means by which feed-back (cybernetic) control can be applied to the Effective Public Decision Process.

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III. INSTITUTIONALIZATION OF TECHNOLOGY ASSESSMENT

C. Implementing Technology Assessments

Raphael G. KASPER, ed.
John M. LOGSDON, ed.
Ellis R. MOTTUR, ed.

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165-169;
75-90;
257-284

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CHAPTER 9

Limitations On Implementation Of Technology Assessment

Harold Green began the discussion by briefly reviewing the history of the concept of technology assessment.* He felt that

> . . . Congressman Daddario introduced the notion of technology assessment . . . because he was concerned that while technology was developing very rapidly in many areas, the adverse consequences of technology were also increasing at a very rapid rate. Somehow our system of social control was not keeping pace with the risks of technology. In the early days, it seems clear to me, technology assessment had more of a negative than an affirmative thrust. Congressman Daddario was somewhat more interested in protecting our society against the risks of new technologies than he was in trying to assure that we had the maximum possible benefits from new technology.

But the notion of technology assessment began to change:

> Whereas Daddario clearly regarded technology assessment as something which would assist Congress in making decisions by trying to give Congress a fair dose of the adverse, negative, risk factors of technology as well as the affirmative or beneficial factors of technology, the more people that talked about technology assessment, particularly in the scientific community, the more people came to think of it as the kind of exercise which might help in the making of correct decisions. [That is, they thought of it as] . . . something which would insure that rational, logical, correct decisions would be made.

Professor Green was puzzled by the idea that the results of technology assessments should be implemented. To talk about the "implementation of technology assessment"

> . . . we have to talk about a technology assessment that is performed by a body of great stature . . . .Therefore I am rather skeptical that the mere fact that a committee of PSAC, for example, undertakes a study of the supersonic transport or DDT or what have you, and comes up with some conclusions, ought to justify an assumption or belief that the particular result ought to be implemented.

* The full paper is printed in a separate appendix.

> We have never had a "really authoritative technology assessment group" which is recognized as such by all members of the society. But even if a group of such character existed, there would be important limitations on the extent to which the results of that group's deliberations ought to be implemented.

Part of the difficulty, Professor Green held, lies in determining just what the "results" are. Are they a "balanced assessment of benefits and risks? If so, "there's really nothing to implement." Are they a "range of possible alternatives which might achieve the same beneficial end?" Are they "recommendations or a ranking of alternative courses of action in terms of a net appraisal of benefits and risks?" The limitations described in the seminar paper are "applicable, at least to some degree" to all of these results.

Professor Green turned to a discussion of the "inherent limitations." The first of these is "the limitation on the identification and measurement of benefits."

> I don't think that it is possible in any real functional sense for one person to reach a valid conclusion about what another person would regard as a benefit . . . . This problem is tremendously complicated and exacerbated when one is trying to ascertain what is a benefit to a community or what is a benefit to a nation. There you are really coping with the summation of a very large number of individual judgments as to what is and is not beneficial. When a technology assessment body attempts to identify and measure benefits, it does so by reference either to the assessor's own value system or to the assessor's opinion of what the value system of the community is. I would suggest that there is no possible way that any assessment body can accurately ascertain what the community as a whole would regard as a benefit.

The second limitation is "on the identification and measurement of risks:

> I think the difficulty there is that it is virtually impossible to measure the risks of a new technology. It may be possible to identify risks just by letting your imagination run. But they are only possibilities. Until you have actually tried something and have some experience with it, it seems to me that there is no way you can tell for sure whether or not there is a risk. One may be able to say with validity that the risk is small or the risk is large. For example, the Congressional Research Study of the SST characterizes the environmental risks of the SST as minor. But there is always a problem of the risk which is attributable to uncertainty. I would suggest that one of the most difficult jobs that one has in identifying and measuring risks is to place a value on the degree of uncertainty one is willing to assume.

Then there is a limitation connected with "any attempt to balance, either implicitly or explicitly the benefits against the risk." Professor Green noted

> . . . The fact that in the early stages there is usually absolutely no evidence of risk and the fact that in the early stages of a technology there is always immense promise of benefit. This means, it seems to me, that in almost every technology at an early stage the benefits are going to outweigh the risks.

He drew a distinction between a privately financed technological development and a publicly financed enterprise. In the latter case there is a tendency to "force the development beyond the level that the market place would permit."

Professor Green called attention to the fact that it is difficult to stop an already established technology:

> The reality of the matter is that it is very easy to start a technology going; all you have to do is provide the money. But when people's jobs become dependent upon it and when people become accustomed to the benefits . . . it becomes quite a difficult exercise to turn off the technology. It is almost impossible to turn it off before very substantial harm has been done.

In addition to the inherent limitations already discussed,

Professor Green called attention to the "political limitation." He used the example of cigarette smoking which was presented in the seminar paper. In this case, in addition to the purely "technology assessment elements" there are a host of political limitations:

> There is the problem of the people whose livelihood is dependent upon growing tobacco and manufacturing cigarettes. There is the problem of people who really enjoy smoking cigarettes and who don't care if they die ten years earlier because they are having fun while they are doing it. There is the problem of liberty -- whether the government ever ought to interfere with what a person does with his own body. And so on.

He continued:

> Any technology assessment, of necessity, has to be only a very small . . . part of the totality of the interests of individual Congressmen and the Congress as a whole. No matter how important a technology assessment may appear to the assessors or to particular government officials . . . it really is a small part of the total picture. There is no way for a technology assessment to make the kinds of trade-offs that have to be made by people who are concerned about the total picture . . . . [In addition] each member of Congress has his own particular value system. Some of them . . . have no interest in life whatsoever other than to advance the economic interests of their own constitutents. And some of them, on the other hand, don't care much about their own constituencies and are interested only in being statesmen. Some are mainly interested in agriculture and some are mainly interested in space exploration. I think it's only to be expected that a Congressman will respond to any particular technology assessment in the light of his own particular interest and priority of values.

He concluded his opening remarks by stating that

> . . . in a democratic society like ours, with pluralistic interests, one cannot expect that truth and logic and rationality are going to prevail in legislative decisions

> about anything. Why therefore should we be particularly concerned about singling out policy for science and technology and ask that it be rational. I am not advocating irrationality. I am simply saying that in the democratic process, where tremendously diverse interests have to be taken into account . . . , you cannot expect to have uniform rationality. Rationality is, I think, more of an exception than the rule. And if one looks at the tremendous range of important decisions that are made in our society, like, for example, what our policy should be with respect to the Vietnam War or who should sit on the Supreme Court . . . , I think it kind of anomalous that we even think about singling out policies for science and technology and expect that we should have a higher order of rationality or correctness in that area than in these others . . . . I think that technology assessment is vitally important . . . . But I think we are doing the concept of technology assessment and our whole political system a disservice if we try to cast technology assessment . . . as some kind of rational, error-free orthodoxy to be imposed upon our political system. We ought to concentrate our efforts with respect to technology assessment on trying to give the Congress the kinds of information that can enable it to do a better, but certainly not an error-free, job in enacting laws.

A. Values, Politics, and Assessment

A lawyer agreed with the speaker that technology assessments generally contain value judgments:

> I think that what the paper is pushing for makes eminently good sense: to surface the value decisions that are in the assessment itself, in addition to those which are made after the assessment is delivered. The values that are implicit in the assessment have to be surfaced somehow if a reasonable or responsible, but not necessarily rational, debate is to proceed.

A university researcher saw many of the recent technology efforts as seeking to do this by increasing

> . . . the number of points of contacts between the overall political system and the scientific and technical community. In earlier days, decisions that were made within the scientific and technical community were viewed by society as,

> on the one hand, so highly technical that the public at large could not really understand them and, on the other hand, not of much general, immediate significance to the society . . . . In that period, it was thought that you could have some sort of perfect technology assessment which would just yield a solution which could be imposed. We are now at a point where . . . science has got to become an integral part of our overall society just like any other segment of the political community in America.

A government official felt that it was possible to separate questions of value from questions of data and facts in assessments. Many issues "are perfectly well subject to analysis and experiment." He cited certain environmental effects of the SST as being amenable to such analysis. He continued:

> It simply takes a willingness to invest a certain amount of thought to find out what the factual information is and to lay . . . such questions to rest. Now that's the kind of thing that I can see as a totally do-able assessment project. That is where the questions involve hard, empirical data that you can simply go out and get if you have the willingness to do so. They are quite different from the questions that are measures of the public will and public policy. I think it is necessary to make reasonably sharp distinctions between those things that you can pretty well settle on the basis of numerical evidence and experimentation and those things that are primarily normative. We have institutions that already are supposed to worry about most of the technical issues.

A university professor, however, was "not sure that we can dispose of the technical versus the political that easily." He too referred to the SST controversy and cited the Congressional Reference Service Study "which was intended as a technical report . . . but which has some very interesting political implications." The report, which minimized the environmental effects of the SST, "raised some interesting questions about the involvement of an agency like the CRS in a very

sensitive legislative issue." He noted that "you are really involved in the political process just by the act of giving a technical report on a very sensitive issue." A Congressional Research Service representative agreed that Congress makes decisions by a

> . . . process of negotiating, of bargaining, of kicking around ideas -- some of which are highly technical and some of which are highly emotional, political, normative, value judgments. There are all kinds of reasoning processes that go on all the time in the Congress or in the public.

The Congressional Research Service SST study sought to "help the Congress ask the right questions" and not "to argue in favor of the SST." The study tried to point out that the economic problems, rather than the environmental ones, were the crucial ones. A member of the National Academy of Sciences staff, however, felt that the selection of environmental data used in the study prejudiced its conclusions. The choice of data and the choice of issues to be considered make the process of assessment a "value-laden" one, "even though there is a sincere attempt on the part of the assessors to make sure that value considerations are excluded."

B. Limitations on Assessments

A government official and 'futurist' disagreed vehemently with Professor Green's contention that there are limitations on the

analysis of benefits. He commented that the notion that an analysis of benefits cannot be made

> . . . flies in the face of roughly forty years of sociological and social psychological investigations which tell you that, in fact, there is no aspect of human behavior or human enterprise which cannot be effectively evaluated and scaled.

It is "not impossible to establish benefits." As for risks, he continued

> . . . there is a whole enterprise called Bayesian probabilities which is designed to deal with the very area that the paper says one cannot deal with; namely, subjective probabilities. This is a quantitative, well regarded, respectable academic enterprise.

Another government official sought to pursue the role of empirical evidence in the assessment process. He called attention to the fact that the seminar paper indicates that

> . . . risks cannot really be identified and measured with any real confidence until the technology has been used sufficiently . . . to provide a basis for empirical judgment. I wonder if we could expand at all on the prospect for having an empirical approach play a larger role in the kind of questions that are addressed by technology assessments. Is it feasible to get the society in a state in which we will try a little of something and observe the consequences before we try a lot?

Professor Green enlarged upon this point:

> There is no substitute for experience. I do not think that the mind of man is capable of predicting events with the degree of accuracy required to provide assurance for the protection of the public interest.

But a university professor saw problems in such an approach. Some effects of technology are irreversible.

> . . . If something is reversible, then we can let society respond to it and react to it; but there are some things that we are dealing with or will deal with in the future where a yes or no decision may be catastrophic.

It may be difficult to know, in advance, which decisions will have disastrous results so that the decision to experiment may be fraught with danger

C. Other Comments

There was brief discussion of the differences, for the assessment process, between privately and publicly funded technology. One participant disagreed with the seminar paper's contention that private financing will necessarily result in slower development than public funding. He cited the introduction of large numbers of Boeing 747's in 1970 and 1971, as evidence that "investment decisions are made from the viewpoint of optimizing the return on investment and they don't necessarily imply a very systematic or orderly introduction of new technology." He continued:

> People who have been involved in environmental controversies think that sometimes it is better to oppose private projects and other times it is better to oppose a government project. It just depends upon the power of the particular agency and the resources and political savvy of the industry involved.

Professor Green felt that perhaps too much significance had been attributed to "my so-called dichotomy between public and private;" but that

> . . . generally speaking, I would defend the proposition that it is easier to shoot down a privately financed technology than a publicly financed technology. On the other hand, I would also make the point that a technology assessment is really required when the Congress has to make a decision on whether to appropriate a large sum of money for the supersonic transport; and you don't necessarily need a technology assessment when Boeing or Lockheed makes a corporate decision to spend a large sum of money.

In all likelihood, we would not feel any need to have a technology assessment of a privately funded SST until the plane was about ready to go into the air.

One participant saw a basic problem in "an imbalance in the sources of information available to decisionmakers." Opponents of new technologies, he held, often are unable to generate and present information to the same extent that proponents can.

A lawyer drew an interesting parallel between attitudes toward technology and attitudes toward assessment:

> I would suggest that one's attitude toward technology assessment reflects one's attitude as to whether technology holds the promise of solving the perceived problems in the society. Those who think technology holds many or most of the answers . . . are likely to be more generous in their treatment of technology assessment; and those, including myself, who are less satisfied that technology has in it solutions to existing problems are likely to be much less charitable towards the concept of technology assessment.

He went on to hold that it is necessary to develop ways to achieve a greater pluralism in examining the effects of technology; "what is needed . . . is to have a wide variety of people giving their own views on the likely consequences of technology." The failures evidenced to date indicate that "we haven't had enough variety."

One government official and 'futurist' attacked the speaker for an alleged lack of logic in his paper and presentation, and voiced his distress at

> . . . the absolutely incredible anti-intellectual tone of the whole discussion, largely because the people who are involved in the discussion have absolutely no appreciation of the limits of science and technology and are primarily wedded to technology

as pictured in the textbooks of 1920 . . . . The discussion has essentially reflected the attitudes of lawyers and soft scientists toward what technology means. There wasn't a single discussion . . . that mentioned such things as computer simulation which is a major input into anticipating outcomes. There wasn't any discussion of the place of modelling in addressing these questions. There was no discussion of a calculus of values. Now all of these are fundamental to what we are talking about; but they nowhere entered into the discussion and I don't think that you can adequately address the issues without drawing on them.

"Technology assessment" has been so broadly defined that it can credibly describe almost any analysis of the impact of a technological application. The diverse phenomena classified as technology assessment tend to a corresponding diversity in the processes by which assessments are linked to action. This chapter consists of five case studies of specific technology assessments and the ways in which they influenced (or did not influence) the development the assessed technology. These case studies were chosen to illustrate the variety of situations which must be analyzed before any generalizations regarding the assessment-acceptance-implementation process can be advanced. The case studies are:

A. Jamaica Bay/Kennedy Airport

B. Jet Aircraft Noise Abatement

C. Nuclear Power Plant Radiation Standards

D. Cayuga Lake Power Plant

e. Storm King Power Plant

The Jamaica Bay/Kennedy Airport case, which involved a study of the environmental impact of an extension of the runways at Kennedy International Airport into Jamaica Bay, is a good example of the potential influence of expert opinion and public sentiment which coalesce in the assessment-acceptance-implementation process. The assessment was performed by a multi-disciplinary team of experts operating independently of the Port of New York Authority, the agency which initiated the study. Contributions from the public were encouraged and numerous public groups were involved in the performance stage of the assessment. The results of the assessment were widely disseminated through local and national media, thus providing a focal point

for aggregating public opinion. The results of this comprehensive assessment and the anticipated public reaction to it were responsible for the Port Authority's decision to abandon its plans for a runway extension at Kennedy Airport.

The Jet Aircraft Noise Abatement study involved action by both the executive and legislative branches of government. The assessment in question was initiated in the Executive Office of the President. Members of a White House Jet Aircraft Noise Panel performed the assessment and recommended a comprehensive plan for solving the noise problem. The Congressional response to the panel's report was to authorize the Federal Aviation Administration to prescribe rules and regulations for the control and abatement of aircraft noise. The absence of significant organized public involvement and the problem of communicating highly technical information to a non-technical audience resulted in the public's virtual exclusion from the assessment-acceptance-implementation process. A concomitant result was a disproportionate amount of pressure from the aviation industry on the FAA and its rule-making process. The result was a piecemeal approach to the jet noise problem, one which lacks both sufficient evaluative criteria and the coordination necessary for generating workable and effective regulatory standards.

The Nuclear Power Plant Radiation Standards case illustrates clearly the potential problems created when various biases (or appearance of biases) are introduced into the assessment-acceptance-implementation process. The same analysts initiated and performed the assessment. The distinction between the regulatory and promotional roles of the Atomic Energy Commission (AEC) became blurred in both the performance and presentation stages of the assessment. The influence of special interests, accompanied by their own group biases, reached its zenith during the decision-to-act stage. Such

biases were evident, however, throughout all phases of the study and highlight the role of the adversary process in the conduct of technology assessments, as proponents and opponents of existing standards present conflicting points of view. The public had little direct involvement in the assessment; the preponderance of experts and interest groups favorable to the development of nuclear power as well as the promotional bias of the AEC and the Joint Committee on Atomic Energy were powerful forces contributing to the AEC's decision to formally reject the assessment.

The Cayuga Lake Power Plant case was distinguished by a lengthy and intensive performance stage marked by a variety of investigations into the New York State Electricity and Gas Co (NYSE&G) plans to build a nuclear-fueled powerplant on the shores of Lake Cayuga. In addition to NYSE&G, analysts, groups of scientists, public-interest groups, and state policymakers and regulators actively participated in the performance stage. Numerous viable alternatives to the nuclear powerplant were presented. Yet, while each of the parties involved appeared prepared to promote its own alternative, none gave much consideration to the other alternatives. NYSE&G eventually decided to postpone activity on its construction permit application to AEC as a cross-current of pressures flowed from the various participating groups. The case illustrates the problems which may accrue from the absence of any integrative mechanism for bringing together the results of alternative assessments and for funneling those results into the policymaking process.

The Storm King Mountain Power Plant case, which involved an attempt to balance the requirement for increased electric power with the need for a greater effort to protect the environment, highlights the importance played by the nature of the initial assessment in the acceptance-implementation process. None of the major parties involved in the Storm King controversy

had the capacity or the responsibility for performing the broad assessment that was required. Even if such a capability and accompanying mandate had existed, the absence of a hierarchy of priorities for environmental policy would have made it difficult to assess accurately alternative policies and programs. The case is still being argued in the courts and the uncertainty of the litigation has forced Con Ed to delay project implementation. In the meantime, the assessment process continues and new problems are being identified. The case illustrates how problems associated with the performance of the assessment can continue to affect the implementation process.

In order to provide a common framework for the description and analysis of these case studies, they are each organized in terms of a single analytic framework. This framework is constructed in terms of steps in the assessment-acceptance-implementation process and the participants in that process. Eight steps in the process have been identified:

1. Initiation--the stimulus or situation which leads to the conduct of an assessment. This could be as specific as a directive from an appropriate authority to perform a technology assessment or a statutory requirement to do so or as broad as public reaction to a situation which makes an assessment desirable.

2. Performance of the Technology Assessment--the actual analysis of the consequences of applying a technology. Since this study is not primarily concerned with the conduct of a technology assessment *per se*, the consideration of this step will be limited to those factors realted to later steps in the process.

3. Presentation of Results--the report of assessment findings and recommendation, if any. The assessing entity presents the results of its analysis to other interested parties, formally and/or informally.

4. Decision to Act--the determination that an action is warranted. Legitimate authorities formulate a decision on the issue to which the assessment was directed. Such a decision may or may not reflect the findings of the assessment. The decision to act may incorporate some aspects of the assessment or use information or data generated in the assessment.

5. Planning of Action--separate (at least analytically) from the decision to act. A plan of action is developed which implements the assessment findings.

6. Approval of Plan--acceptance of the plan of action. The plan of action is approved by appropriate authorities.

7. Implementation of Plan--The plan is put into effect by the appropriate participants.

8. Monitoring and Evaluation--determination of the effectiveness of the action. The impacts of the plan are recorded and compared to the desired impacts.

Seven participants in the assessment-acceptance-implementation process, differentiated in terms of their roles in the process have also been identified:

A. Developer/User/Promoter--These participants have direct, usually economic, interest in the application of the technology under consideration, because it would provide some positive benefit to them.

B. Analysts--These participants carry out the assessment and monitor and evaluate its results.

C. Policymakers --These participants have the legitimate authority and responsibility to make decisions initiating courses of action legally binding the opoulation and/or affected segments thereof.

D. Administrators--These participants are responsible for executing courses of action recommended by policymakers.

E. Regulators--These participants are responsible for applying general standards established by policymakers in order to control operations or activities covered by those standards.

F. Adjudicators--These participants have the responsibility for resolving conflicts which result from the execution of the policy decision or from the application of standards to specific cases or situations.

G. Public/Public Interest Groups--These participants are identifiable primarily by their absence from the other six categories of participants; specifically, public interest groups are those organized entities which purport to speak for some segment of the general populace.

The analytic portion of each of the following case studies uses these concepts as a tool for extracting from the case studies potential aspects of general relevance to the assessment-acceptance-implementation process.

CHAPTER 4

Automotive Air Pollution And Problems of Implementation of Technology Assessment

John Esposito began the discussion by stating that he operated on the "assumption that the automobile is here to stay."* He noted that in examining the problem of air pollution from automobiles we are

> . . . attempting to deal with an unforeseen consequence of what is a giant enterprise in the United States. For two-thirds of this century, the automobile industry has not been subject to any really substantial regulation. I think this results in there being a large vested interest in warding off government regulation and retaining the freedom to do things pretty much as the industry pleases . . . . It is a natural tendency on the part of organizations to want to operate as freely as possible.

He felt that the central thesis of his paper bore repeating:

> I . . . emphasize the structure and self-defense mechanisms of the auto industry because I believe that the making and implementing of technology assessments is an intensely political process. A system of politics requires that government make choices from among the demands of competing interests. In short, in its role as arbiter of a particular controversy, government must decide which groups will win and which will lose. When power, access to government, and control over information are virtually monopolized by one group, the outcome will be predetermined. With a relatively few insignificant exceptions, this is what has occurred in the field of automotive air pollution control.

* The full paper is printed in a separate appendix.

The speaker then reviewed the stages in the automobile industry's response to the air pollution problem:

> First there was a period of outright denial . . . on the part of the industry which said that there was no evidence to indicate any real connection between the automobile and health hazards. This is, I think, a standard pattern in the sense that the general thrust has been to assume that the public has the burden of proof as far as health hazards are concerned and that industry will continue to do pretty much what it pleases until the government has proved rather conclusively that the activity is a dangerous one.
>
> . . . .
>
> When scientific evidence began to mount, the industry entered a second stage and that is the study stage.
>
> . . . .
>
> The next stage was an acknowledgment that there was an air pollution problem and it was related to the automobile, but that it was confined to Los Angeles because of L.A.'s particular topographical and meteorological patterns.
>
> . . . .
>
> The next step, when the forces of government and the public began to close in, was an attempt to delay regulation.

Mr. Esposito felt that the lesson to be drawn from this sequence is that "a tightly oligopolistic market does not respond to demands which it has not created." He continued:

> It seems clear that the industry meticulously limited the dissemination of information concerning its capacity to control pollution and was shaken out of its complacency only when it found itself under the gun.

A major impediment to the implementation of programs designed to reduce automotive air pollution was the inclusion, in the National Emission Standards Act of 1965, of the phrase

> . . . "technological and economic feasibility." In other words, in setting the standards, the Secretary of HEW had to take into account the technological feasibility, as far as the industry was concerned, and the economic burden that it might place on the industry. This sounds, at first blush, like a perfectly reasonable position to take except when you are dealing with a situation where the sources of information are so tightly controlled as they are in the automobile industry. As a consequence, . . . Federal standards were not very ambitious. But even these rather modest standards were not effectively met by the automobile manufacturers.

The speaker discussed two "rudimentary technology assessments" of recent years: the Morse Report which concluded that electrically powered vehicles were not presently feasible and which "rather strongly endorsed the potential for steam engines and the turbine engine;" and the report of the Senate Commerce Committee entitled "The Search for a Low Emission Vehicle" which "emphatically endorsed the steam engine as a feasible alternative to the internal combustion engine." There has not been a great effort on the part of the manufacturers to develop alternative engines. Chrysler has done a great deal of work with the turbine engine

> . . . but it is my feeling that we are not about to see the introduction of the turbine engine by the Chrysler Corporation. This is directly related to the structure of the automobile industry. Although Chrysler is the fifth or sixth largest manufacturing corporation in the United States . . . it cannot realistically make any innovations that the General Motors Corporation does not accept. General Motors, in effect, calls the shots in the automobile market. It sets styling trends; it has enormous advertising budgets; and it can effectively divert consumer choices away from those areas it does not want to see emphasized.

Mr. Esposito charged that "the automobile industry has spent irresponsibly small amounts of money on air pollution control." He

repeated the questions raised in his paper about whether even the small amounts spent in this area go into a "sincere effort to develop effective pollution control devices" or into discouraging the discussion of innovative proposals.

He felt that

> . . . much of the monolithic stand of the industry could be traced to a cross-licensing agreement which has existed since 1955. Very simply, that was an agreement among the automobile manufacturers to pool all of their information resulting from research in air pollution control and also, very importantly, to jointly assess patents offered by outsiders to any one of the companies. I think this effectively disarmed the inventor of any bargaining power he might have had and effectively precluded competition in the area of air pollution control.

The paper outlined the charges made by the Justice Department in its complaint filed against the Automobile Manufacturers Association and the four major automobile manufacturers. The case was settled by consent decree, and

> . . . I think there are some questions about the remedial effect of the consent decree. I don't think it reached all the questions raised by the complaint itself. Secondly, I think the consent decree foreclosed the opportunity for what was probably the first really open discussion in a court of law of at least one very important aspect of the self-defense mechanism of the automobile industry.

The speaker endorsed the concept of legislative standards for pollution control and noted that the 1970 Clean Air Act Amendments, which set such standards, indicate a change in attitude from the past:

> In the '30's, I think reformers tended to see the administrative process as the answer to all problems. They saw the judiciary as the enemy, and such notions as due process and the rest as being unnecessary devices

> in bringing about social change. Now there is a great disillusionment with the administrative process; there is a feeling that it has become antiquated; it's atrophied; it has become a captive of the regulatees, and the points of access are monopolized by those who are supposed to be regulated. So I think that what occurred in the Muskie Legislation, the idea of legislating a specific deadline, is excellent. This is something we may begin to see in many other areas. It is interesting to note, also, that in the lobbying it was . . . the automobile companies and other industries that lobbied for continued administrative discretion in these areas.

Mr. Esposito concluded his opening remarks by noting the three areas in which he feels public policy decisions must be reevaluated: the scope of the assessment, which should be greatly broadened; the size and structure of the automobile industry, which must be considerably altered; and Federal research into alternatives to the internal combustion engine, which must be expanded.

A. Alternatives to the Automobile and the Internal Combustion Engine

Mr. Esposito called attention to the need to develop an alternative to the internal combustion engine:

> I think that one of the reasons for the push toward alternative sources of power is that it makes such good sense to put an engine which has inherently low emission characteristics into an automobile. Such an engine can be compared to the internal combustion engine which is a "Rube Goldberg," and which is a very complicated engine and a very dirty engine. Then you tack on a device, a cork, and charge $50, $75, or $100 for that cork. And you are not sure whether that cork is going to work. Why not go to a propulsion system that has inherently low emissions as part of its operating characteristics.

An industry representative pointed out that all of the alternative sources yet proposed are either difficult to develop or cause environmental problems themselves. For instance, electric vehicles would produce less pollution from the automobile itself, but would cause pollution problems from the huge generating capacity required to provide electricity for charging the batteries. But a Congressional aide found this to be a specious argument:

> The easiest place in the world to control pollution is in an enormous electric plant where you can afford to install all kinds of . . . equipment. This is the place where economies of scale help to control pollution.

Mr. Esposito granted that there were problems connected with all of the alternatives to the internal combustion engine, but he felt that these problems could be resolved more readily than could those of the internal combustion engine. He agreed with the point about controlling pollution from the generation of electricity:

> Electric cars . . . would provide a way to concentrate the environmental problems in the sense that you might be able to control emissions from a utility or from a relatively small number of power stations that might be located throughout a city more easily than you could chase after every single driver in the city.

A Congressional aide raised a more basic question: "Isn't there a better way of moving people around this world than in automobiles of one sort or another? A university professor agreed that this was an important question to address for

> . . . it never fails to amaze me that the American people are so devoted to this uneconomical and rather bizarre transportation system to the extent that they will fight traffic jams and parking jams morning and evening.

When one participant attributed this acceptance of the automobile to the fact that "they don't really have many alternatives" a university professor pointed out that

> . . . you can't really say that other forms of transportation didn't exist. They did exist but they couldn't survive. There was a time when mass transportation was well-developed and extensive, but it just couldn't survive the competition of the automobile. You have to ask the question of whether the failure to survive was essentially economic or political. I think that it was economic. Now you can ask whether mass transportation was driven out because the automobile was given a sufficient unfair advantage through various subsidies. I don't know if that's true. I really do suspect that competing forms have disappeared because they couldn't stand the competition in view of consumer preferences. You see this going on in Europe. Europe still has well-developed and attractive public transportation systems. But look at the way the use of automobiles is escalating in Europe with the growth of incomes there. They are going through exactly the same sort of thing that we went through twenty or thirty years ago.

A university researcher agreed: ". . . the fact remains that no matter how good a mass transportation system you have, it can never offer the mobility and flexibility of cars."

Several participants attributed the lack of viable alternatives to the automobile to the fact that the automobile manufacturers, with their powerful lobby, have made certain that attractive alternatives are not made available. But a university professor was

> . . . not so sure that General Motors is not doing precisely what the overwhelming majority of the members of the American public want it to do. I think that a very strong argument can be made that the automobiles which are being manufactured today, from the exhaust to the asbestos brake lining, are precisely what the American public wants . . . . If the American public were confronted with all of the facts about air pollution, the effects of air pollution on health, and

> the economic costs of eliminating air pollution, I have serious doubts that it would opt to eliminate air pollution if the costs were going to be substantial. What is happening today with respect to General Motors is precisely what the political system is permitting and encouraging. I don't think we should damn General Motors.

Mr. Esposito did not agree:

> I think that your universe is too narrow when you say that GM is doing precisely what the public wants. You are assuming consumer sovereignty. But the options have not been offered to the public. I would like to see the results of a referendum taken after a thorough analysis and a comprehensive scheme and real options were offered to the people. Until then, I think that of all the principles or assumptions one could adopt, the assumption of consumer sovereignty is one of the weakest.

He added that "Detroit, and others who have profited from the automobile, have foreclosed or have tried to foreclose our options." A Congressional aide agreed. He called attention to the fact that

> . . . when you try to talk about a rational transportation program in Congress, the way the automobile lobby descends on you is really frightening to see.

B. <u>The Need for a Broader Assessment</u>

Mr. Esposito noted that

> . . . we have never had a wide enough scope of assessment so that the other options are made available. I don't think you can really say that the people will inevitably choose the automobile if, in fact, they have a comfortable, low-cost, and non-dehumanizing form of mass transportation available. But no assessment has presented a series of options from which to choose.

But a university researcher insisted that

> . . . the fact is that you are all contaminated with that American idea that you can do anything that you want to do. But at any point in time, it's possible that some problems are insoluble.

While this speaker was referring to the possibility of producing attractive alternatives to the automobile, a university professor was bothered by a similar attitude toward cleaning up the automobile:

> I am sort of intrigued by the tremendous amount of this 19th century faith in technology as being able to solve every problem. There is the assumption in this discussion that technology can solve the problem and make a clean car if you just put enough money in it. This isn't necessarily true.

But Mr. Esposito insisted that such comments were of limited value because the scope of the assessment to date has not been broad enough: "All the issues you raise are legitimate issues and should be evaluated in a rational way;" but we are not assessing things in a comprehensive enough manner today to arrive at definite conclusions about public choice or the ability of technology to help solve the pollution problem.

C. Setting Standards and Enforcing Regulations

An interesting exchange occurred between an industry representative and Mr. Esposito over the proper interpretation of the fact, reported in the seminar paper, "that up to 75% of the so-called controlled vehicles actually in use failed to meet federal standards." The industry representative pointed out that air pollution standards are

set inorder to preserve a certain level of air quality. Thus, it is not important that all cars meet the standards; it is only important that the total of all emissions from all cars be less than a certain standard. He noted that

> . . . when the regulations were set up, they were supposed to take care of the atmosphere. The atmosphere is the greatest averaging thing there is.

Thus, the intent of the regulations is to maintain an acceptable level of environmental quality, which will prevail if the average emission from all cars is low enough. He claimed that the emission from any single car is insignificant; thus it is not essential that any particular car meet the standards.

When the industry spokesman tried to explain his point by claiming that emissions from automobiles fall on a "bell-shaped" curve, Mr. Esposito noted wryly that "the bell has a tremendous crack in it." It was clear to him that the meaning of the regulations was that each and every car must meet the standards. In fact, if this were not the case the regulations would be absolutely unenforceable. He pointed out that there is no provision in the regulations that only some of the cars produced must meet the standards. Although the limiting of total emissions of all cars may well have been the intent behind the regulations, the actual regulation as written requires each car to meet the standards. This is the only way that the regulation can be realistically enforced.

D. Role of the Economic System

An industry representative felt that it was somewhat "incongruous" for defenders of the consumer to argue for increased pollution control since

> . . . in the kind of society we are in -- no matter who might pretend to pay for thing -- it is the general public which pays for everything in its taxes and in the price of products. So this [pollution control] ends up being a price that the public is going to pay somehow or another.

But Mr. Esposito noted that the public is already paying for pollution control devices -- he estimated that one and a half billion dollars has been paid for the "clean air package" and the like -- but that those devices do not work. In addition, while he agreed that "the consumer will have to absorb the additional cost of pollution control," he claimed that

> . . . there is a strong likelihood, to say the least, that the costs of pollution control as they affect the consumer don't reflect the cost to the manufacturer.

He related this point to the nature of competition in the automobile industry:

> I think that until we return to some semblance of a true market situation here, costs will be passed on to the consumer with no guarantee that they accurately reflect costs to the manufacturer. Part of the reason is that the industry is not subject to traditional market restraints.

However, a university professor wondered whether breaking up the oligopoly was any solution. He wondered whether

> . . . the chances for pollution control or any other protection for the consumer might be greater in a market which is concentrated than in a cut-throat market which is very competitve. I wonder whether firms in a competitive market would want to add to the costs of business. It would seem easier for a company . . . to absorb the cost if it could control the market.

But Mr. Esposito believed that

> . . . the larger the number of industrial units we have, the more difficult it is . . . for industries to come up with unanimous positions. In addition, in a de-concentrated market you will have increased the possibility that you will have some diversity, in quality as well as choice. In a more ideal market, some of the competitors might see pollution control as one of the ways of getting competitive advantage.

In response to a question about the amount of funds which industry is spending on pollution control, an industry representative said that "there has been no limit on the amount of money that we want to use in any project as long as it's for emission control." This led to the following exchange between a university researcher and the industry spokesman

> Researcher: Are you really asserting that if the government were to offer GM and the other manufacturers an additional $150 to $300 million for R&D on this, the companies couldn't find ways of using it?
>
> Industry Representative: I meant what I said. We get all the money we want.
>
> Researcher: People always cite the space program as an example. Why is it that the country could move to a budget of billions of dollars so quickly in areas which are much more difficult and require much more innovation? Why is it that it is so difficult to build the pollution control effort into a more extensive and effective effort more rapidly?

> Industry Representative: The know-how basically to do the job was known when the goal was set to be on the moon in ten years. We knew, but we didn't have the hardware developed. The money was involved in the actual hardware development, not in developing the principles for doing the job.
>
> Researcher: So the actual technical principles that you have to contend with are more difficult than those in the space program?
>
> Industry Representative: We don't know some of them yet.

One participant was bothered by industry's "self-righteousness" and arrogance in dealing with its critics. He doubted that industry was really serious about pollution control. A Congressional aide, however, saw no reason to be surprised by the attitude of the automobile industry:

> It is naive for people to believe that General Motors is acting as a good citizen; it is equally naive for people to believe that General Motors should act as a good citizen. The job of the corporation, as it functions in our society, is to make a certain amount of money. The only reason it would possibly change its policy would be that it becomes more expensive to do business without a change.

E. Industry and the Political Process

A university professor saw two ways that industry could react to the problem of automotive air pollution:

> One which is the undertone of Mr. Esposito's paper, is to use its power within the confines of the political process to undercut any effective government regulation. The other is to respond to coercion, such as government subsidies to their competitors, and to actually do

> something [to reduce pollution]. This second course may be the one which the industry is following. You know, large organizations want to avoid having government sitting on top of them. If the most effective way that they can see that avoided in the near future is by developing some kind of process that will make government keep off their backs, rather than exerting their weight in the political province, why not give them the benefit of the doubt?

But several of those present felt that the industry's record in the past made clear that no benefit of the doubt was deserved. A public interest lawyer noted that

> . . . many of us feel that the automobile industry doesn't seem able to meet the pollution problems; it doesn't seem able to meet the safety problem; it doesn't seem able to meet the repair problem. It will not make a cheap, easily repairable model which does not change its design from year to year. What do you think of the suggestion that the design of automobiles be taken away from industry and be given to government agencies with the industry simply allowed to contract to make the automobiles?

Mr. Esposito saw this as a "potential option;" but a Congressional aide felt that this would be a disastrous alternative "since Federal agencies very quickly become the satraps of the industries they are supposed to regulate." He quipped, "I'd be very leery about setting up a Federal agency to do something better than GM because I suspect they'd work out an agreement in restraint of trade."

A university professor felt that the problem under discussion had profound implications for our political system:

> We all have ideas about the values and precepts that should underlie a Constitutional system which says that there is a public sector and a private sector and the job of the public sector . . . is to arbitrate among competing private interests. But "private

> sector" isn't the right phrase when you speak of General Motors . . . . The whole set of values that underpin our political system don't tell us a thing about how [the relationship between GM and the government] should work. We need a new system of thinking about our political values.

F. The Relative Roles of Administrative Bodies and Legislatures

A government official took issue with Mr. Esposito's critical remarks about the role of administrative bodies concerned with the environment. He noted, for example, that the Environmental Protection Agency was newly formed and to call it "antiquated, atrophied, or the prisoner of the regulatees is not quite fair." This led to the following exchange:

> Mr. Esposito: You said that EPA is not atrophied yet?
>
> Government Official: I suggested that it would be unfair to assume so at this point.
>
> Mr. Esposito: It is basically an umbrella organization for a whole host of atrophied agencies.
>
> Government Official: That's a provocative way of putting it.
>
> Mr. Esposito: Maybe some life can be injected into them.

An industry representative saw need for a regulatory body of some sort:

> Because the auto industry supports the administrative approach to the application of regulations, it is assumed that the administrative approach must be wrong. I don't know if I necessarily agree with the logic.

He endorsed the basic procedure whereby government should set clear requirements for the industry to satisfy. But

> . . . our problem here is that we need some people in the regulatory group (whether it turns out to be legislative or administrative) that understand the technical part of the problem. We don't have those kinds of people in the Legislative Branch today. If you are going to propose that we do all future regulation by legislation, then let's get the technical expertise into the legislature. After all, the business of building an automobile is a technical one.

Mr. Esposito responded that

> . . . there is a need for additional expertise, but I think this is a basically political judgment. I think the Legislative Branch is the appropriate branch to resolve this . . .

The industry representative claimed that the Legislative Branch

> . . . usually doesn't have the time or staff to . . . assess the technical problems. For example, if Congress should decide that there should not be any more automobiles because the air pollution problems are so bad, that would be a technical decision.

Mr. Esposito disagreed:

> I think it is a clear-cut political decision. If Congress should decide to ban the automobile, there are not many technical questions to be raised. I think it pushes all technology aside.

A university professor emphasized the political nature of the decisions involved. He argued that

> . . . it is misleading in the extreme to talk about a particular technological impact, such as air pollution from the internal combustion engine, as being good or bad, right or wrong. Whether it is good or bad or right or wrong is a political question. It's not really susceptible to factual analysis in any meaningful public policy sense. The problem lies at the doorstep of the political process which has allowed it to exist. Everything in our society is controllable through the political process. The real problem is how to perfect the political process . . . .

CHAPTER 15

AN OVERVIEW OF THE ASSESSMENT-ACCEPTANCE-IMPLEMENTATION PROCESS

In order to discuss the acceptance and implementation of technology assessments, it is first necessary to identify briefly various types of technology assessments. This is so because the notion of accepting and implementing an assessment implies that, explicitly or implicitly the assessment includes findings or conclusions which point to a particular policy choice. Thus, a summary discussion of assessment-acceptance-implementation requires an analysis of how the findings of the assessment influence policy formation, selection, and execution. Yet, not all assessments are designed with this function in mind.

Coates differentiates three types of assessments: (1) a neutral analysis; (2) a search for desirable choices; (3) an advocate's tool. A neutral assessment would be an "application of scientific analysis to future outcomes and alternatives." This type of assessment, says Coates, is "raw material" for those who wish to influence policy choice. The second type of assessment is one that "goes a step beyond the even-handed analysis of consequences" to "highlight various desirable policy options." The final variant of assessment is one which is used to support "whatever position an advocate chooses to take."[1]

Obviously, what is meant by acceptance and implementation of a technology assessment varies with the type of assessment involved. If the assessment is a neutral one, with no explicit policy recommendations, then its acceptance means that some partisan of a particular course of

action either has become convinced that that course is desirable because of his evaluation of the assessment or that the assessment's findings reinforce his own preferences. If the assessment is one which identifies desirable choices in its conclusions, then its acceptance means the acceptance of its policy recommendations. Finally, if the assessment is an advocate's tool, designed to support a preselected point of view, its acceptance means that the advocate's viewpoint prevails in the conflict over policy outcomes.

The five case studies in the preceding chapter can be separated according to assessment type.

1. Jamaica Bay/Kennedy Airport

This assessment probably comes closest of the five cases analyzed to being a neutral analysis. It concludes that "runway construction will damage the natural environment of the Bay and reduce its potential use for conservation, recreation, and housing."[2] Even this assessment, however, was reported in a document which then went on to outline recommendations on issues beyond that of runway construction including plans for the management of the Bay and the improvement of service at Kennedy Airport. All of the matters considered in the assessment had been and continue to be matters of great public and political interest. This may suggest that "no matter how objective an assessment might be, it will become embroiled in political controversy if the matter is important."[3]

2. Jet Aircraft Noise Abatement

This assessment is clearly an example of the second type--a search for desirable choices; it assessed the sources and consequences of jet noise and recommended a comprehensive set of policies required for noise abatement.

3. Nuclear Power Plant Radiation Standards --
This assessment is also an example of the second type, although it is much less clearly so. Gofman and Tamplin's initial analysis seems to have met most of the canons of scientific inquiry, and their findings and the conclusions could have been challenged by challenging the scientific validity of the research which led to them. However, the challenge took the form of attacks on the analysts and their actions, and in later presentations Gofman and Tamplin began to treat their analysis more as an advocate's tool than as the result of purely scientific inquiry.

4. Cayuga Lake Power Plant--
This assessment was in fact composed of a set of partial assessments. Without analyzing any of these in great detail, it is probably valid to conclude that the overall assessment has elements of both the second and third of Coates' types. Some, perhaps most, of the partial analyses were performed by competent scientific teams and the findings of these analyses led to specific conclusions regarding preferable courses of action. But apparently, there were also elements of partisanship in the design and execution of some of the studies, particularly those commissioned by the promoters of the nuclear power plant.

5. Storm King Power Plant --
In this assessment, which again was a series of partial analyses conducted by different performers, elements of advocacy seem to have been prevalent. This is probably because most of the analyses were conducted within the context of the proceedings of a regulatory agency and a court. As Coates comments, those who see assessment primarily as an advocate's tool "see the courts and regulatory agencies as taking the lead in managing

technology. Since the law operates on an adversary basis," he says, technology assessments tend to be "structured to fit that pattern."[4]

A. The Political Nature of An Assessment

One conclusion that emerges from the preceding discussion is that, viewed from the perspective of its acceptance and implementation, any effective technology assessment is, in part, political.* That is, in order to have influence (to be acted upon), an assessment must be an element in the public policy-making process. That process, through which a course of action is selected from among competing alternatives, is, itself, always political in that its outcome is determined, at least in part, by considerations of power. Acceptance and implementation, in this view, are "socio-political processes flowing from and anticipated by early phases of the policy process. This...is recognized in the consideration of technical, economic, and political feasibilities in the rational analysis and political negotiation leading to the formulation of policy content."[5] Even "neutral" technology assessments imply decisions, and decision-making, as Bunker notes, is a combination of rational analysis and political negotiation. Etzioni suggests that "the effectiveness of a decision will depend as much on its power-backing as on the validity of the knowledge and the decision-making strategy which were used."[6] If an assessment is viewed as an input to, and thus a part of, decision-making, then it is possible to analyze the assessment-acceptance-implementation process in terms of how its early stages--initiation and performance of an assessment--affect the later stages of acceptance and implementation. As Etzioni comments:

> The two processes [decision-making and implementation]... are closely interwoven, with decisions affecting implementations and initial implementations affecting later stages of decision-making...There is a continual give-and-take between decision-making and implementation.

* This theme runs throughout the seminar discussions in Part I, as well.

Moreover, "early decisions shape the power which affects later decisions, and the more the initial decision took relevant power into account, the more effective implementation is going to be."[7] Folk makes the above point specifically related to technology assessments: "If viewed as part of the policy-making process,...technology assessment must be adapted to the existing political process in which special interests, restricted and fragmented government jurisdiction, and untrustworthy advice flourish."[8]

At a recent meeting on technology assessment, Anthony Wedgewood Benn, a Member of Parliament in the United Kingdom, emphasized strongly that policy-makers and decision-makers will ignore technology assessments as long as assessors feel that their work can be done in the seclusion of ivory towers, divorced from the realities of the political process and from the wants and desires of the constituents of elected officials. He urged that technology assessment be viewed not as a purely academic pursuit but rather as an input to policy and decision-making responsive to the needs of government decision makers and their constituents.[9]

If the assessment-acceptance-implementation process is viewed as Folk and Benn see it, that is, as one type of the general relationship between analysis, policy choice, and policy execution, then it is possible to consider that process in terms of more general discussions of public policy-making. One basic issue that arises immediately is: how do policies get selected and executed in a pluralist political system in which power is widely distributed? The accepted answer is that pluralist policy-making is

based on a dynamic process of the formations and dissolutions of coalitions in support of a particular course of action. Bunker comments that "policy activation cannot be achieved on a command basis, but must be accomplished through mobilization of support and the interweaving of both information and performance contribuions from a variety of sources."[10] Lindblom describes the effects of pluralism: "power is always held by a number of persons rather than by one; hence policy is made through the complex processes by which these persons exert power or influence over each other."[11] If this perspective is valid, then the assessment-acceptance-implementation process can be analyzed in terms of how an assessment is involved in the formation of the coalition of interests and/or power which leads to its acceptance and eventual implementation. The issue can be stated somewhat differently: at what stage of the assessment-acceptance-implementation process should coalition formation occur if an assessment is to be acted upon?

There seems to be a consensus in the policy studies literature that the likelihood of policy execution is increased if coalitions in support of such action are formed during the early stages of the policy process. Dror notes that

> Identifying a "good" best policy and executing it are two different phases; the second does not necessarily follow from the first. Some "motivation"...must be introduced for executing the policy, allocating resources to the executing, and "pushing" the executing...
>
> Giving or withholding such motivation is a main function of political power. Gaining the necessary support for a policy involves building a coalition of power centers that together control most of the power that is concerned with the problem the policy is about.

Dror also notes that "action-oriented policy making allocates a considerable weight to the policy's chances of being supported by a

coalition strong enough to motivate its execution, and this allocation distinguishes such policy-making from 'utopian' policy-making" and that "groups which are most likely to be in the coalition often should be involved very early in the policy-making activity itself."[12] Bunker suggests that "policies which emerge from the interaction of rational analysis, political leadership, and administrative discretion are not only more likely to be made operational; but a policy process characterized by active involvement of participants from these functions is likely not to be so fragmented as to impair capacity for execution."[13]

It is necessary at this point to attempt to specify the acceptance and implementation outcomes of the cases studied:

1. Jamaica Bay/Kennedy Airport --

This assessment was accepted and implemented. The logic of its analysis called for the abandonment of plans for a runway extension; this recommendation was acted upon immediately after receiving the assessment.

2. Jet Aircraft Noise Abatement --

This assessment was accepted by both the President and the Congress, but its implementation, which was the responsibility of the Federal Aviation Administration, has been partial at best.

3. Nuclear Power Plant Radiation Standards --

This assessment was rejected by those with legitimate authority to take actions based on its recommendations but these same authorities did later take actions closely resembling those recommended by the assessment.

4. Cayuga Lake Power Plant

This assessment was conducted in the context of an adversary process in which many positions were taken. Thus it is not easy to speak in terms of acceptance and implementation of an assessment, since there was no

one such analysis. Rather, the assessments here were integral parts of the process of policy debate, not outside inputs to it. The decision not to continue to seek a construction permit from the AEC represents the acceptance and implemenation of what came to be the "majority" view among the performers of assessments in this case. The meaning of "majority" is crucial here: Given the perspective adopted in this chapter, it can mean only that greater power was held by the coalition of interests opposed to the power plant than by the plant's supporters.

5. Storm King Power Plant --
The assessment of the Storm King Power Plant, like that of Cayuga Lake, was conducted within an adversary process in which many positions were taken and most of the preceding comments on the Cayuga Lake case apply to it. However, in the Storm King case, the power held by those supporting and opposing the construction of the plant varied with the forum in which the debate took place. The ultimate outcome--rejection of the opponent's analyses and at least the interim approval of the Storm King project--seems linked to the fact that the project's promoters performed a successful enough "counter-assessment' to undercut the advantages the opponents had gained in the judicial forum.

Different coalition-formation strategies were followed in each of the cases. In the Jamaica Bay study, there was prior agreement that the findings of the study would be publicly disseminated. The issue was highly salient to the media, interested citizen groups, and the general public. This tended to assure that the public would be made aware of the assessment and that public opinion would support any assessment finding that reinforced existing attitudes. The study team, although it conducted the assessment in isolation from day-to-day outside pressures, did actively

seek citizen involvement in its deliberations, This meant that, at least in part, the assessment could be said to reflect a public consensus (or the study team's perception of a public consensus). When the findings of the expert analysts turned out to parallel that consensus in most respects, a powerful coalition of experts and the public was formed, and given the political and environmental context of the time, it was impossible for PONYA to make any decision except to abandon plans for runway extensions. The coalition between expert and citizen illustrated in this case is becoming an increasingly powerful one, especially with respect to environmental issues. A National Academy of Sciences study of technology assessment recognized the importance of extensive citizen participation in the assessment process both for practical reasons and in the light of democratic theory. That study suggested that early citizen participation helps avoid belated citizen opposition and that "objective evaluation" of social costs and benefits is impossible unless the diverse views of interested parties are considered.[14]

In the jet noise abatement case, acceptance and implementation were dependent on the support of different sets of participants.* Analysts and policy-makers cooperated in initiating, performing, and accepting the assessment, but the resulting implementation plan delegated authority to administrators for its execution. As is often the case, the most influential clientele of the administrators was directly affected by the policy the administrators were supposed to implement. The coalition of interests and perspectives between bureaucrat and clientele groups is often strong enough to resist major policy shifts imposed by top level policy-makers, even with expert and some public support. The delegation of implementing

* The participation of various interests in this case is also discussed on pp. 141 ff., above.

authority to administrators often results in potentially significant policy shifts being transformed into incremental changes only.* This was the situation in the jet noise abatement case.

A similar description fits the radiation standards case. Here expert analysts consciously attempted to create a coalition in support of their views because they recognized the power of the opposing coalition, which consisted of the AEC (in a joint promoter-regulator role), nuclear industries, the"establishment" in nuclear science, and the Joint Committee on Atomic Energy. In their attempts to form a coalition based on Congressional, professional, and especially informed public support, Gofman and Tamplin alienated the opposing coalition to the extent that a compromise on the explicit acceptance of their recommendations became impossible. As the case study suggests, it is not possible to state unequivocally that the power of the "Gorman-Tamplin coalition" was great enough to force informal acceptance and implementation of the analysts' conclusions.

The Cayuga Lake case was marked by the development of a variety of positions ranging from relatively uncritical interest in the construction of a nuclear power plant on the lake to virtual oppotion to the project. A central role in the assessment was played by an ad hoc citizen group, The Citizens Committee to Save Cayuga Lake. This group attempted to play a mediating role by organizing a coalition which would agree on a plan for the construction of a power plant modified to reflect opponents' criticisms. Ultimately, the attempt to organize such a moderate coalition failed, and opponents of the plant were able to persuade its promoter to end the quest for a construction permit. It appears that the extreme positions in support of and opposition to development of the plant had become so

* Milton Katz commented on the relationship between administrative discretion and administrative power in the discussion of his paper, p. 126.

firm during the course of the assessment that it was impossible to bring the various parties into a compromise agreement.

The coalition-formation strategy in the Storm King case was even more marked by the polarization of positions. Like the Cayuga Lake case, an _ad hoc_ citizens group was formed, the Scenic Hudson Preservation Conference. But unlike the Cayuga Lake group, this group served as a focal point for organized opposition to the power utility's plans and the government regulatory commission's support of those plans. The task of allocating values between promoters and opponents of the plant went to a Federal Court of Appeals. Reliance on a formal mechanism for resolving the conflict, rather than on the informal process of negotiation and bargaining, mitigated against any tendency to compromise on the part of the plant's opponents, who felt that the courts gave them a means of achieving their desired end--abandonment of plans for the plant. However, the majority of the court became satisfied that the plant's supporters had so modified both their plans for the plant and their analyses supporting their plans that there were no grounds for court intervention in the licensing process. In so doing, the court in effect joined the coalition of interests in support of the plant's development,

It is apparent then that in the one case in which an accepted assessment was not implemented--the Jet Aircraft Noise Abatement case--those involved in implementation efforts were not included in the coalition of power which had supported the performance and acceptance of the assessment and its findings. One analyst suggests that "from the point of view of facilitating the utilization of analysis, mutual adjustment between the analyst and the user is essential."[15] Such adjustment was not

the case in the assessment of strategies for jet noise abatement nor even in the formulation and passage of legislation to accomplish that end. The insertion of the "economically reasonable and technologically practical" clause in aircraft noise abatement legislation represented the emerging influence of the user/regulator coalition late in the policy formulation process. This type of coalition was able to use that clause to delay implementation of stringent noise standards for aircraft engines. The situation here illustrates Theodore Lowi's complaint that "modern law has become a series of instructions to administrators rather than a series of commands to citizens. Delegation has been elevated to the highest of virtues....Bargaining must be preferred over authority at every level and phase of government."[16]

In the other four cases, there were attempts to form coalitions between analysts, public interest groups, and/or the public. In one of these cases, Jamaica Bay, the technique used was to ensure in advance that the results of the study would be publicized and then to actively involve citizen groups in the assessment itself. To the degree that the assessment findings would reflect the citizen input, the assessors could feel confident of public support, even if PONYA decided not to accept those findings. The Authority recognized this, it seems, and decided not to try to advance its plans over the combined opinions of citizens and experts. By contrast, Gofman and Tamplin performed their assessment without public involvement, and then tried to mobilize broad support behind its findings. It is not clear that they were completely successful in this attempt. This may suggest that citizen involvement in the performance of the assessment itself can contribute importantly to the acceptance and implementation process, particularly

when the policy-makers involved in policy choice and execution are in postions relatively more susceptible to influence by public opinion.

The separate roles of expert analyst and public interest representative collapsed into a single, joint role in the Cayuga Lake and Storm King cases. Here the performers of many of the partial assessments were experts who had been motivated to carry out the assessments by their concern as citizens and were interested in the assessment findings because they would be useful tools in the conflict over whether the power plant (in each case) would be built. This is a good example of what Lindblom calls "partisan analysis." In this form of assessment, "policy analysis is no longer an alternative to a play of power; it becomes largely an instrument of influence or power." Such analysis is practiced by interest groups, including public interest groups, which wish to influence those with the ability to make policy choices. This is particularly true when policy-makers must "look realistically into the merits of alternative policies and...demand competent analysis"[17] in order to be able to decide which alternative is most desirable. In both power plant cases, the original assessments were prepared by those with a vested interest in the technology application under consideration, and it was not until opposing "partisan analyses" appeared that those with the power to decide were forced to consider <u>not</u> approving that application. The judicial process, of course, provides an institutionalized forum for "partisan analysis," since decisions are reached only after assessing the merits of opposing arguments.

Lindblom argues convincingly that it is "unrealistic" to expect that policy analysis--and technology assessment is being viewed here as

a particular type of policy analysis--can reach "conclusive determinations of correct policy." But the fact that analysis is not determinative does not mean that it is not influential. Rather, "policy analysis is incorporated... into the play of power, changing the character of analysis as a result."[18] Charels Schultze suggests that

> The purpose of the advocacy process and political bargaining is to reach decisions about specific programs in the context of conflicting and vaguely known values. Systematic analysis makes a major, and essential, contribution to this process by forging links between general values and precific program characteristics.[19]

Certainly, this is what happened in the Cayuga Lake and Storm King cases, and perhaps, in all the cases studied. By focusing attention on the total range of impacts of a technological applications, assessments tended to force policy-makers to consider alternate means for the achievement of objectives agreed upon by a limited elite.*

B. Stages of the Assessment-Acceptance-Implementation Process

In addition to the preceding discussion of the overall process of assessment-acceptance-implementation, it is possible to make some specific comments about each of the stages in that process.

* The tendency for technology assessments to force explicit consideration of alternative goals and values as well as of alternative means was frequently mentioned in the seminar discussions in Part I. See, for example, the discussion on pp. 155-156.

1. Initiation. In all of the cases studied, assessments were performed without any formal or legal requirement that they take place. Institutionalized initiations of technology assessments, such as by Section 102 of the National Environmental Policy Act of 1969, did not influence directly the decision to perform assessments in these five cases. In most of the cases, assessments were performed either as a result of or in anticipation of generalized public pressure which demanded some form of assurance that a proposed or existing activity would not threaten important values held by the public. This pressure was particularly strong when the effects of the technology application were highly visible to the general public, as in the jet noise and Jamaica Bay cases. When the potential effects were important but not readily apparent, those perceiving the issue organized public interest groups to create the pressure required to include technology assessment as a part of the policymaking process. Only in the radiation standards case was an assessment initiated without any explicit pressure from the public for its conduct. Thus in none of the cases studied was there a structured means for public involvement in the decision that an assessment was required or in the decision regarding what to assess. Yet these were critical decisions, and much of the "messiness" of the performance stage, especially in the Cayuga Lake and Storm King cases, was a result of public demands for the broadening of previously narrowly-defined assessment to include a wider range of considerations. By contrast, the Jamaica Bay study was broadly conceived at the initiation stage, and public participation in the performance stage was both orderly and constructive.

Policymakers seem to prefer not to have assessments performed at all, and if they are performed, to have them designed to examine only a narrow range of issues. The pressure to initiate broad technology assessments, or to transform narrow ones into broad ones, comes either from analysts acting as public interest representatives or from the public itself. Because there was, at the time Gofman and Tamplin conducted their study of radiation effects, no public pressure for careful attention to this problem, the Atomic Energy Commission was able to claim that there was no need for the Gorman and Tamplin study or for any further AEC analysis. By contrast, there was enough public attention being paid to the jet noise issue to force both the PONYA and the Johnson administration to initiate assessments related to that issue.

In the absence of institutionalized means of initiating technology assessments,, such analyses are likely to be begun only in response to pressures for their existence. But the presence of such pressures increases the likelihood that the performance of the assessment will be to some degree politicized, since those demanding an assessment are likely to also demand an active role in carrying it out. Perhaps the development of assessment as a routine activitiy to be performed prior to discussions related to the application of a technology will increase the likelihood that assessments can be carried out in a less politicized environment.*

2. Performance. The case studies provide clear contrasts with respect to the performance stage of the process. In three cases, the

assessments were performed by analysts functioning more or less in isolation from outside pressures. In the other two cases, the performance stage was characterized by the involvement of a wide range of participants and by the assessments themselves explicitly being part of an adversary process preceding a policy decision. Yet, no clear pattern emerges as to which mode of assessment is more likely to produce the enlightenment policymakers require in order to improve the quality of their decisions. Mayo suggests that neither what he calls the "scientific method" of technology assessment nor what he calls the "adversarial system" will result by itself in an adequate assessment. He argues that uncertainty during the performance of an assessment both as to facts and as to value preferences among affected populations will inevitably lead to the use of some form of an adversarial mode of inquiry as part of the process of technology assessment.[20] This seems to have been the situation in four of the case studies. In the one assessment which had the least impact--the jet noise study--there was little controversy over assessment findings either during the performance stage or thereafter. In the other cases, conflicting views were considered as a structured part of the assessment process (Jamaica Bay), were an integral element of the process (Cayuga Lake and Storm King), or were generated by the initial assessment (radiation standards). Folk

* Affecting the initiation of assessments, according to Green, is the likelihood that, in early stages of a technological development, there is a greater perception of potential benefits than of potential costs of further development. This means the pressure for an assessment (in anticipation of future problems) is not likely to be great unless there is general agreement that assessments should be undertaken or there is an institutional mechanism for initiating assessments. See p. 153 ff above for a further discussion of this point.

suggests that "criticism and debate is sic an essential part of the democratic process. It is only through adversary proceedings that that part of a policy assessment which is solid may be identified, and that part which is insupportable may be shown up for what it is."[27] The case studies suggest that this will be more likely if the adversary proceedings (or, at least, the expression of conflicting views and interests) are somehow incorporated into the performance of the assessment itself.

One effect of an adversary element in the performance of assessments and illustrated by the case studies is the potential for extending the performance stage itself for an indefinite time, as adversaries continue to disagree, or until some authoritative policymaker takes an action which effectively terminates the performance stage. Also, if the assessment becomes a continuing process and not a specific time-defined analysis, there is a tendency for assessments to become increasingly partisan and to be used as an advocate's tool, with the qualificiations and limitations of assessment findings given less and less prominence as the process continues. This suggests the need for some balanced means of obtaining diverse views and for challenging emerging conclusions during the assessment process while at the same time providing for terminating the assessment and presenting its findings on a timely basis.

3. Presentation. One generalization that emerges from the case studies is that, if an assessment is to be implemented through the actions of governmental authorities, then the findings of that assessment must be presented in such a manner as to generate pressure on government for such action. This means that there is a need fomaking the assessment conclusions accessible and understandable to a non-specialist audience, probably through media coverage. The importance of making impact analyses intelligible to laymen was emphasized in a recent court decision concerning a river basin development project in Texas. Although that decision deals

with environmental impact statements rather than with complete technological assessments, the point made by Judge Bue of the U.S. District Court for the Southern District of Texas is easily generalizable:

> All features of an impact statement must be "written in language that is understandable to non-technical minds and yet contain enough scientific reasoning to alert specialists to particular problems within the field of their expertise." [Environmental Defense Fund v. Corps of Engineers of the U.S. Army, 348 F. Supp 916, 933 (N.D. Miss., 1972)] The reason for this standard is that impact statements must assist in rational, thoroughly informed decision making by officials higher up in the agency chain of command, including the Congress, the Executive and the general public, some of whom may not possess the technical expertise of those who evaluate the impact and prepare environmental statements. . . . Additionally, when technical procedures are discussed, such as with the benefit-cost analysis issues, the applicable law and methods employed should be adequately explained so that all may understand them.[22]

This did not happen to any great extent in the jet noise case, since the assessment findings were contained in a report prepared for the Executive branch and not given wide distribution. Gofman and Tamplin faced this problem in publicizing the results of their analysis, and, in the attempt to make their conclusions dramatic enough to gain wide general support, seem to have so departed from "acceptable" modes of presentation that they alienated many of their peers in the nuclear energy community. The choice of a target to receive assessment findings may be an important element in increasing the likelihood of their acceptance and implementation. In neither the jet noise nor the radiation standards case did the performers of the assessment attempt directly to convince the technology users--the AEC and power utilities in one case; the FAA and the airlines in the other--to accept their findings. Rather, they attempted to present those findings in ways that would create outside pressure which could then

be used to force such acceptance. This seems to have been a less successful strategy than the one followed in other cases in which assessment findings were presented both directly to those with the authority to accept and implement them _and_ to a broader audience whose pressure could force the authorities to consider the assessment. This is related to earlier discussion of the fact that assessments change the "resistance pattern" decision-makers face when they feel the necessity to act. _It would be desirable to understand more fully the relationship between how the findings of an assessment are presented and the degree of influence that the assessment has._

4. _Decision to Act_. Most of the generalizations which might be made regarding this stage in the assessment-acceptance-implementation process have already been analyzed in earlier portions of this chapter. Our central conclusion is that the decision-making process cannot be made totally rational through the performance of technology assessments, since those assessments cannot provide a conclusive "correct" analysis in any meaningful situation. This is so primarily because decision-making with respect to the application of technology involves not only the choice of appropriate means but also selection among conflicting values. Dror notes that "rational elements play an important, though limited, role in specifying and ordering of values. . . . Final values and their order of priority can only be determined by value judgments, not by rational processes."[23]

The method for making such collective value judgments for a society is the political process. Technology assessments link specific proposed activities with their value implications in a way which permits the

bargaining, negotiation, and power play of the political process to produce a meaningful translation of social values into specific decisions."[24]

Technology assessments appear to affect the decision to act in two ways. One is by making more clear the consequences of various alternative actions. The other is by assessments themselves being instruments of power which directly act on the decision-makers; this power is exercised through the persuasion of "partisan analysis." Lindblom observes that "officials are not on the whole pushed around . . .[T]o be effective interest groups do indeed have to persuade--and with better instruments than misrepresentation.[25] The case studies illustrate both effects. In the Jamaica Bay and jet noise cases, the assessments served primarily to highlight the link between particular actions and their social impact. In the other cases, the assessments served both this function, and perhaps to a greater degree, the function of instruments of direct influence on the decision to act.

5. Planning of Action. In the five cases studied, only two, the jet noise and Storm King cases, included this stage. Both demonstrated the difficulty of developing an integrated and coherent plan of action in the context of a pluralistic political and administrative system, one with many interests represented at many points. Lowi's complaint seems relevant here: "Liberal government cannot plan. Planning requires the authoritative use of authority. Planning requires law, choice, priorities, moralities. Liberalism replaces planning with bargaining."[26] This somewhat extreme view might be tempered by modifying it to suggest that, in our governmental system, "law choice, priorities, moralities" are most often the result of a political process rather than any more "rational"

mode of activity. Thus planning (as well as decision-making) takes place in the context of conflicting interests, usually guided by some general policies which set limits to acceptable plans. But often, those involved in such planning activities are able to modify the intent of a general policy to suit their particular interests. Gergen notes that "although an idea may be effectively initiated, it may function as any empty 'campagin promise' until specific plans have been laid out be qualified persons. The leverage of such persons is often far greater than would meet the public eye."[33] The case studies suggest that there is considerable leverage held by administrators and regulators, often in cooperation with users or developers, is considerable when it comes to developing specific plans for the implementation of assessments, even after the findings of those assessments have been accepted by policymakers.

6. Other Stages. The discussion of the approval of plan, implementation of plan, and monitoring and evaluation stages in Chapters 10-14 essentially exhausts what might be said about these stages on the basis of the five case studies. The last two of these stages are found only in the jet noise case.

C. IMPLEMENTING TECHNOLOGY ASSESSMENTS

The analysis in this chapter, and indeed the whole report, suggests that the crucial time to insure that the findings of an assessment are accepted and implemented is in the early stages of the assessment-acceptance-implementation process, particularly during assessment initiation and performance. Once an assessment is completed and the decision to act towards which the assessment was directed is made, the process of implementation, at least as shown by the case studies,

does not appear to differ very much from the process of implementing any other policy decision. This suggests that the influence of technology assessments is likely to be higher on the policy formulation process than on the policy execution process. Yet the findings of assessments appear also to have had at least some indirect effects on policy execution in addition to those effects flowing from policy decisions influenced by assessment findings. The modification of low-level radiation standards by the AEC, even after the rejection of the Gofman/Tamplin analysis, is one example of this. Another is the redesign of the Storm King plant by Con Ed even though the Federal Power Commission did not require such action.

In general, however, the problem of implementing technology assessments seems to be similar to the problem of assuring that laws and other policy decisions are carried out by administrators and regulators in a manner consistent with both their letter and their spirit. The relationship between policymaker and bureaucrat in contemporary government is one of the most important ones in determining whose interests are served by government. The existence of technology assessments can (but not necessarily will) assure that policymakers, and the public that they represent, have a powerful tool in the effort to make government policy serve the public interest (as determined through the political process) and not only limited interests with access to the non-representative elements of government structure.

D. Technology Assessments and Value Conflict

Probably one of the most important impacts of technology assessment is that it shifts conflict and bargaining from means to ends. This shift in the arena of conflict, of course, makes it more difficult for those who control political decision-making to assemble the agreement required to insure that selected policies are carried out. Etzioni notes that "a major task of any political elite is to construct a whole from societal parts; dissensus is costly and hinders the elite's ability to fulfill this function."[28] One conclusion that emerges from the case studies is that the performance of a technology assessment as part of the policy-making process modifies that process in terms of how general values are translated into specific policies.* Dror suggests that "organizational decisionmaking tends to follow the line of least resistance."[21] The performance of technology assessments can be viewed as changing the "resistance pattern" which forms the context of decisionmaking. The question, the, is the nature of this change and its implications for effective <u>and</u> responsive social policymaking.

* This point was made by Representative George Brown, arguing that "the process of assessment in itself creates a wider perception which is the essential ingredient in the ultimate program of implementation. . . ." (p. 108)

By exacerbating the value conflicts that the political process attempts to reconcile, technology assessments can produce one of two general types of result: A first possibility is that technology assessments are more effective as instruments of "technology harassment" than as instruments of balanced decisionmaking. By highlighting the conflicting value implications of particular proposals, an assessment may make it impossible to reach a consensus on an acceptable course of action, and thus nothing is done even in situations when most of those involved in the policy process agree that some activity is desirable. This perhaps was the case in the Cayuga Lake situation. Dror notes that "sometimes specifying values can be dangerous to the very existence of the system" designed to select policy by reconciling conflict.[30] Gawthorp notes that:

> The zone of viable negotiation, which can be controlled exclusively by the professionals as long as conflict can be narrowly contained, diminishes substantially when the bargaining arena is forced to absorb a high influx of amateur advocates. When the nonprofessional enters into a conflict situation, he introduces many of the elements that the professional is committed to ignore....As a consequence, system instability dramatically increases while the prospects of a compromise solution achieved by professionals within a collegial atmosphere visibly evaporates.[31]

A second possible result of technology assessments is that they increase the quality of social policymaking by forcing policymakers to give attention to

ends as well as means, while at the same time providing a way of minimizing the social and political conflict such attention can produce. This is probably most likely if assessments include as meaningful performers those likely to be involved in accepting and implementing their findings. Such involvement, however, is likely to change the assessment process itself. Dror says that "the need to form a coalition sets some limits on how explicit goals can be, and determine some structural characteristics of optimal policymaking in that the groups which are most likely to be in the coalition often should be involved very early in the policymaking activity itself."[32]

What is implied here is the conclusion that <u>in order to have a "productive" impact, assessments must be designed and executed in the overall context of political decision-making</u>. This does not mean necessarily that assessments, to have influence, must themselves be advocate's tools. It does mean that the design of the assessment and the choice of those involved in its performance should be made with a sensitivity toward the political feasibility of getting the assessment findings acted upon. This suggests that the design of mechanisms for public participation in at least setting the value context within which assessments take place, if not in the actual performance of the assessment itself, should be a central element in the assessment process. The requirement for meaningful participation increases the need for and difficulty of what Dror calls "metapolicymaking," i.e., concern with the impact of the structure and operation of the policymaking system on the substance of policy.[33] To design a means for increasing public participation in the early stages of the policymaking process (beyond providing the generalized demand for action that stimulates the policymaking system into operation) is a "metapolicymaking" task of the first order. Technology assessments represent an opportunity to provide such a means, if they can avoid being either mere symbolic manifestitations of public participation or convenient instruments for the opponents of technology-based change.

1. Joseph F. Coates, "Technology Assessment: the Benefits...the Costs... the Consequences," The Futurist, December, 1971, pp. 227-28.

2. See Chapter 10.

3. Hugh Folk, "The Role of Technology Assessment in Public Policy," in Albert Teich, ed., Technology and Man's Future (New York: St. Martin's Press, 1972), p. 248.

4. Coates, pp. 227-28.

5. Douglas Bunker, "Policy Sciences Perspectives on Implementation Processes," paper delivered at meeting of American Association for the Advancement of Science, Chicago, Illinois, December 27, 1970 (mimeo), p. 2.

6. Amitai Etzioni, The Active Society (New York: The Free Press, 1969), p. 303.

7. *Ibid.*, pp. 303-04.

8. Folk, p. 246.

9. Talk by Rt. Hon. A. Wedgewood Benn, M.P., at the First International Congress on Technology Assessment, June 1, 1973.

10. Bunker, p. 16.

11. Charles E. Lindblom, The Policy-Making Process (Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1968), p. 29.

12. Yehezkel Dror, Public Policymaking Reexamined (San Francisco: Chandler, 1968), pp. 188-89.

13. Bunker, p. 7.

14. National Academy of Sciences, Technology: Processes of Assessment and Choice (Washington: Government Printing Office, 1969), chap. III-IV.

15. Bunker, p. 5.

16. Theodore Lowi, The End of Liberalism (New York: Norton, 1969), p. 144.

17. Lindblom, Chapter 3 and pp. 117 and 65.

18. *Ibid.*, pp. 117 and 30.

19. Charles Schultze, The Politics and Economics of Public Spending (Washington: The Brooking Institution, 1968), p. 74.

20. Louis Mayo, <u>Scientific Method, Adversarial System, and Technology Assessment</u>, Monograph No. 5, Program of Policy Studies in Science and Technology, George Washington University, November, 1970.

21. Folk, p. 249.

22. <u>Sierra Club</u> v. <u>Froehlke</u>, 5ERC 1033, 1067 (Southern District of Texas, Houston Division, 1973).

23. Dror, p. 165.

24. See Schultze, pp. 55-56, for a further discussion of this point.

25. Lindblom, p. 66.

26. Lowi, p. 101.

27. Kenneth Gergen, "Assessing the Leverage Points in the Process of Policy Formation," in Raymond Bauer and Kenneth Gergen, eds., <u>The Study of Policy Formation</u> (New York: The Free Press, 1967), p. 187.

28. Etzioni, pp. 177-78.

29. Dror, p. 82.

30. <u>Ibid</u>., p. 176.

31. Louis Gawthorp, <u>Administrative Politics and Social Change</u> (New York: St. Martin's Press, 1971), pp. 48-49.

32. Dror, p. 189.

33. <u>Ibid</u>, pp. 160 and 164-76.

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III. INSTITUTIONALIZATION OF TECHNOLOGY ASSESSMENT

D. Technology and Public Policy: The Process of Technology Assessment in the Federal Government

Vary T. COATES

July 1972 (Summary, pp. 1-47)

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TECHNOLOGY AND PUBLIC POLICY: THE PROCESS OF TECHNOLOGY ASSESSMENT IN THE FEDERAL GOVERNMENT

INTRODUCTION

Technology assessment is the systematic identification, analysis, and evaluation of the real and potential impacts of technology on social, economic, environmental, and political systems and processes. It is concerned particularly with the second and third order impacts of technological developments; and with the unplanned or unintended consequences, whether beneficial or detrimental, which may result from the introduction of new technologies or from changes in the utilization of existing technologies. Technology assessment seeks to identify societal options and clarify the trade-offs which must be made; this approach is designed to provide an objective and neutral input to public decisionmaking and policy formulation with regard to science and technology. The analytical techniques of technology assessment may be integrated into the on-going process of planning, designing, and evaluating technological projects and programs, and may also provide an external review and evaluation of such projects and programs at any point in time.

In a highly industrialized society such as the United States, the interaction between technology and public policy is continual

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and complex. Federal executive agencies perform and fund research and development; they foster, subsidize, use, and regulate technological applications. Political theorists of the nineteenth and twentieth centuries have grappled with the problem of the capacity of democratic systems to control and direct technological forces to serve societal needs and to protect public interests. The relationship between the State, the corporation, interest groups, and the individual is a central concern of modern political thought. On a more immediate level of concern, the interaction of social goals such as rising standards of living, equitable distribution of material goods, and maintenance of the physical environment has brought into question the viability of existing governmental institutions and their capability to deal with complex problems arising from socio-technological change.

Technology assessment has been advanced as a way of enabling decisionmakers to better understand and anticipate the societal impacts of technological developments. If technology assessment techniques can be developed and routinely integrated into legislative and administrative decisionmaking and public policy formulation, more rational choices can be made among alternative policies and actions. Anticipating problems and detrimental side-effects which result from any public action will permit their moderation or reduction.

In 1966, Representative Emilio Daddario, as chairman of the Subcommittee on Science, Research, and Development of the House Committee on Science and Astronautics, introduced the concept of

technology assessment, in proposing the establishment of an Office of Technology Assessment to serve the Congress. This occurred at a time of rising public alarm over alleged hazards to life and health resulting from contamination of the environment by the byproducts of chemical and industrial processes. Moreover, large public projects such as highway and airport development had occasioned numbers of public protests, demonstrations, and legal actions resulting in costly delays to many such projects. Growing hostility to technological programs aroused political pressures which intensified congressional suspicion of the process of planning and programming in executive agencies, and congressional resentment of the failure of executive agencies to provide Congress with adequate information about the impacts of governmental programs.

In this atmosphere the concept of technology assessment gained acceptance both among legislators and among professionals and academic specialists in science policy research. In the five years since Mr. Daddario first used the term "technology assessment," many academic and professional conferences and seminars have explored the concept of technology assessment, numerous papers have been presented at meetings of scientific societies, and scholarly journals and publications have carried treatments of the subject. The Subcommittee on Science, Research, and Development, chaired by Mr. Daddario and later by Representative John Davis, held several series of hearings and commissioned four reports on technology assessment, by the Library of Congress

and the National Academies of Sciences, Engineering, and Public Administration.

An underlying assumption in all of the discussion during this five years was that the existing process for planning and evaluating technological projects and programs within federal executive agencies is fragmented, diffuse, and inadequate in scope and depth. The purpose of the research reported in the present report was to carry out an empirical investigation of this assumption, and to provide a descriptive and analytical overview of the process of technology assessment as practiced in federal executive agencies in 1970 - 1971.

The objectives of this research were:

- To identify the loci at which technology and technological programs are assessed by federal executive agencies,
- To describe the process of technology assessment used by federal executive agencies,
- To identify the loci at which the same or similar technologies are assessed, and to determine where and how such overlapping assessments are or could be compared, weighed, or integrated,
- To identify gaps in the existing technology assessment process and to determine where and how such gaps might appropriately be filled,
- To describe typical technology assessments in terms of their initiation, purpose, methodology, research teams, costs, and results, and
- To provide a base of information for use in improving technology assessment in federal agencies and in constructing new assessment mechanisms if these are needed.

Departments and agencies of the Executive Branch were surveyed. Military and national security agencies and departments were excluded to limit the scope of the study. One hundred and forty offices within the civilian agencies were contacted, and their statutory charters, statements of responsibility, organization charts, publications, and research programs analyzed. On this basis, 86 offices were identified as having technological projects and programs.

One hundred and ten interviews were held with officials in the 86 offices. A series of questions, tested and refined through a preliminary set of ten interviews, were used to structure the interviews; however, the interviews were kept informal and questions worked into the conversation as unobstrusively as possible. (These questions appear in Appendix D of the full report.) The interviews lasted from one to two hours and were designed to elicit detailed description of the way in which projects and programs are selected, planned, and evaluated, and of the resources, personnel, and methodologies used in this process.

In the course of interviews, 97 examples of technology assessment and closely related studies were identified, and a further set of questions was used to develop information about their initiation, costs, research techniques, dissemination, and utilization. This analysis was an important final phase of the research.

The remainder of this summary volume presents the conclusions drawn from the research, with a series of recommendations for the

improvement of the technology assessment process in federal agencies. It addresses the following points:

- Who is doing technology assessment?
- The organization of technology assessments.
- Disciplines and techniques used in technology assessment.
- Analysis of a sample of technology assessment studies: initiation, disciplines, techniques, costs, scope, purpose, and utilization.
- Gaps and overlaps in governmental assessment of nine major technologies.
- Prerequisites for further improvement of technology assessment.
- Recommendations.

The full report of which this volume is a summary will appear in two parts -- the report itself, and a volume of appendices designed to serve as a reference volume for full substantiation of the report. The appendices include detailed descriptions of the offices studied, data on each of the 97 exemplary studies, a list of officials interviewed, and the questions used to structure the interviews.

The process through which decisions are made within bureaucratic structures is complex, highly convoluted, and poorly understood. It is anticipated that the information provided by this study will usefully contribute to attempts to understand, rationalize, and improve the decisionmaking process in the federal government.

SUMMARY AND CONCLUSIONS

Federal executive agencies have, within the last five to ten years, improved and broadened the process through which they plan and evaluate technological projects and programs. Whereas economic considerations, especially cost/benefit analysis of immediate planned effects, have been the mainstay of planning and programming, agencies are now taking into account a somewhat wider range of possible consequences of governmental actions and the exercise of federal responsibilities. Most are trying to take account of potential impacts which are derivative of the basic actions or programs, difficult to quantify, and not always satisfactorily translatable into monetary terms. The lack of generally accepted methods for integrating such considerations into administrative decisionmaking, and into the justification of agency programs, and the lack of sustained impetus and encouragement from the highest levels of the Executive Branch, cause this improvement to be slow and not uniform across agencies. But in many executive agencies, these new considerations -- encompassed in the concept of technology assessment -- are gaining general acceptance and systematic technology assessment processes and techniques are developing.

Congress is demanding from public administrators more soundly

grounded information about the possible consequences of governmental actions. The movement in the 1960's for increased public participation in decisionmaking, widespread alarms over alleged environmental hazards, and public protests over many public works projects created political pressures to which Congress reacted. Controversies culminating in court actions against highway, airport, and water resource projects caused costly delays in many projects and created new political obstacles to governmental objectives. Congressional concern crystallized in the National Environmental Policy Act of 1969, which has been the single most important factor in moving executive agencies to accept the idea of technology assessment. The proposed legislation to create an Office of Technology Assessment to serve the Congress (passed by the House in February 1972) underlines the continuing congressional dissatisfaction with Executive Branch methods of assessment and their demand for an independent accounting.

Who Is Doing Technology Assessment?

Eighty-six offices in federal executive agencies were identified as chiefly responsible for projects and programs of a technological nature. These offices were located in seven cabinet-level Departments, nine independent agencies, eight commissions, and four components of the Executive Office of the President. (Defense and security agencies were excluded.) In these 86 offices, extensive interviews showed that 24 percent

were concerned only with primary performance characteristics of technological systems and their direct dollar costs. Sixty-three percent perform or sponsor some technology assessments; the bulk of these are partial or narrow assessments which take into account some of the secondary consequences of technological applications, most often the secondary economic impacts or environmental impacts. The remaining 13 percent of the offices consistently perform or sponsor technology assessments and regard technology assessment as their major responsibility.

In the offices where it is performed or sponsored, technology assessment is viewed as support for agency planning and programming or as ancillary to substantive basic and applied research programs. It is most often found in offices bearing the title "Policy, Programs, and Evaluation" or an equivalent designation (25 percent) or offices solely responsible for research.

Thirty-five percent of offices sponsoring technology assessment reported that most or all such work was done in-house; the remainder preferred contract studies or a mix of in-house and contractor assessments. On 97 exemplary studies collected, 38 percent were performed in-house, 42 percent by contractors (15 percent by university researchers and 27 percent by other organizations), 9 percent by agency and contractors together, 4 percent by interagency groups, and the remaining 6 percent by panels of non-government experts convened by the agencies. Contractors performed or participated in all categories of studies but were

most heavily used for partial or narrow technology assessments (70 percent).

The Organization of Technology Assessments

The advantages of in-house assessment, which was preferred by 35 percent of the offices, were reported to be:

-- they had greater credibility for agency management,

-- they showed greater likelihood of producing institutional change in the agency,

-- individual assessors were protected from constituency pressure by their bureaucratic anonymity,

-- the data base remains available to the agency,

-- in-house expertise is developed and maintained,

-- the assessment activity can be flexibly scheduled in terms of time, resources, and workload.

The corresponding disadvantages of in-house assessments were perceived as:

-- the lack of a multidisciplinary staff in most offices,

-- a relative lack of external credibility,

-- the possibility of institutional bias,

-- the ease of suppression of assessments by administrators displeased by the findings or implications.

Most offices divide assessment activity between in-house staff and contractors depending on the size of the study, the availability of expertise, and the pressure of time and workload. A few officials preferred as a policy to have technology assessments performed by contractors rather than staff.

The advantages of technology assessments performed by contractors were reported as:

- -- there is less institutional bias and greater objectivity,
- -- they have greater external credibility,
- -- more disciplines can be used than are present in most agency offices,
- -- the regular work of the staff can proceed without interference.

In order to further enhance the opportunity for multidisciplinary assessment, there is a growing trend toward the use of consortia of research organizations.

Difficulties and disadvantages of having assessments done by contractors were reported:

- -- there are severe difficulties of coordination and management when agency and contractor are geographically separated,
- -- contractors tend to tell agencies what the agency wants to hear (as the contractor perceives it),
- -- contractor reports can also be ignored or suppressed by agency management.

Officials showed a tendency to prefer independent research organizations over university-based groups, which were reported to have difficulty in organizing a management structure for large interdisciplinary research projects. When only one discipline or one or two researchers were to be involved, some officials preferred university research on the grounds of greater objectivity or greater prestige. Some university researchers who were contacted alleged that their findings were suppressed or misused by

agencies. University groups were also unable in some cases to compete for research contracts because of the rules of their institutions. Analysis of collected studies showed that costs per professional man-year were considerably lower for university groups than for independent organizations.

The advantages of using interagency mechanisms for performing assessments were reported to be:

-- they may have high level visibility and influence, depending on the level of personnel assigned to them,

-- they provide the opportunity for continuing monitoring and assessment,

-- they provide the opportunity to coordinate and rationalize policies of several agencies.

The off-setting disadvantages of interagency assessments are:

-- they are difficult to initiate because of the lack of a sponsoring authority,

-- they are avoided because of conflicting agency missions, responsibilities, and interests,

-- agency viewpoints and interests are seldom overridden, especially if the tasks of analysis are divided among the participating agencies.

"Blue-ribbon panels" of experts from outside of the government, especially from industry and universities, are sometimes convened to conduct assessments, especially those focused on societal problems related to technology. The advantages of using expert panels are:

-- they allow mobilization of expertise from many sources at low cost,

-- they tend to have high visibility, prestige, and influence,

-- they offer the possibility of co-opting powerful segments of society for support of policies or decisions emerging from the assessment,

-- they allow representation of affected interests.

Expert panels also involve disadvantages:

-- there may be bias, or alleged bias, from institutional and occupational affiliations of the members,

-- they show a tendency toward conservatism in approach to problems,

-- the analysis may lack continuity, diligence, and consistency.

It is likely that maximum independence and comprehensiveness is gained when

-- the assessment is sponsored by a source not directly responsible for the program or project being assessed, such as the National Science Foundation or the Executive Office of the President, and

-- the assessment is performed by an independent research group or university group which values its reputation for objectivity as a chief stock-in-trade.

But unless the agency responsible for the program or project under assessment is fully prepared to accept the assessment and integrate the results into its own planning and programming process there will be little gain in terms of responsible decisionmaking.

Disciplines and Techniques Used in Technology Assessment

Engineers, economists, and physical scientists make up the bulk of the staff of offices which perform and sponsor technology assessments. Fifty-four percent of these offices had one or

more engineers engaged in technology assessment activity, 46 percent had economists, and 33 percent had physical scientists, while only 19 percent had one or more social scientists working on technology assessment. In most such offices, social scientists when present constituted only a small percentage of the staff. Analysis of specific studies, however, indicated that social scientists were somewhat more likely to be used in assessment studies than the above figures would indicate, because only 38 percent of the studies were done by agency staff; contractors more often included social scientists on their teams. On these research teams, however, the number of social scientists was again usually small compared to the number of team members claiming other disciplines.

Type of Assessment*	Percentage of research teams on which disciplines were represented by one or more team members:				
	Econ.	Engineer	Phy.Sci.	Biol.Sci.	Soc. Sci.
Wide-scope Assessments(9)	55%	33%	66%	33%	55%
Partial T.A.(40)	41	25	25	16	44
Problem-oriented T.A.(14)	30	20	40	10	10
Futures Research(17)	50	63	13	13	13

<u>Most technology assessments rely heavily on the collation and judgmental analysis of existing information</u>, along with field studies in the case of planned projects. Techniques from

*See definitions on page 18.

established disciplines and academic areas, such as cost/benefit analysis, surveys and interviews, and input-output tables, are often augmented by sophisticated techniques of systems analysis, operations research, and modeling and simulation. Wide-spread government acceptance of and use of these tools for analyzing complex problems is helping to persuade administrators that the complexities of social impact analysis are not beyond reach. Innovative techniques borrowed from futures research, such as Delphi, cross-support matrices, and decision trees were reported to have been used by a small number of offices. Researchers reported that the use of these new techniques occasioned scepticism and resistance in higher echelons of management. Officials also reported with some consistency that the regulatory process in particular has suffered from the fact that civilian agencies (in contrast to DoD) have lagged behind industry in developing a capability for technological forecasting.

<u>The effect of bias from institutional and occupational affiliations of members of expert panels conducting technology assessments is an area in which behavioral research is needed.</u> Such panels are sometimes used, especially for problem-oriented assessments focusing on societal problems (such as pollution, deviant behavior, or regional development) to which technology is either a contributing cause, a possible solution, or both. The use of a panel allows for representation of affected interests, and thus tends to increase awareness of political and institutional

feasibility and constraints; but it introduces a problem of bias and weighting in what is intended to be an objective and neutral evaluative process.

The appropriate role for public participation in assessment also needs further research and innovation. Conventional techniques such as public hearings necessarily occur at an advanced stage of planning or development and tend to crystallize opposition without significantly adding to the base of available information, without generating alternatives to the proposed action, and without providing for representation of the entire range of interests affected. Representation of interests implies the desirability of weighing interests in terms of numbers of people affected (and usually their political or economic power). Technology assessment aims at evaluating impacts in terms of desirable changes for society as a whole. These concerns may or may not be coincident in any particular case for any particular time period.

No innovative methods of incorporating public participations were discovered in this study. NASA has experimented with utilization conferences in planning space station programs, and FAA with consultative planning conferences. Both allow the expression of interests of potential users of systems, but do not provide input from other potentially affected parties, nor do these techniques seek out and identify unplanned consequences of agency actions.

Technology assessment "methodologies" advanced by a number of analysts are basically similar; they can be reduced to a structured analytical process involving several simple steps or tasks:

-- Definition of the subject of inquiry; description of the subject technology and its parameters; development of data base.

-- Description of alternative, supporting, and competitive technologies.

-- Development of state-of-society assumptions, for present and future time periods.

-- Identification of potential impacts.

-- Analysis of and evaluation of impacts in terms of
   (a) affected parties, systems, and processes,
   (b) probability of occurrence, direction, magnitude, and duration of induced changes.

-- Identification of possible action options.

-- Assessment and comparison of alternative action options.

On the basis of evidence from this study, it appears that technology assessment is most adequately performed by interdisciplinary teams using a variety of analytical techniques to accomplish the above tasks, augmented by on-site investigations of specific projects, and with the option of commissioning additional research if needed.

Analysis of a Sample of Technology Assessment Studies

Eighty-six offices in federal executive agencies provided a total of 97 examples of technology assessment and related studies

which were in progress in 1970-1971 or recently completed by the agency and its contractors. Since these studies were provided by agency officials they constitute neither a random sample nor an exhaustive list, but substantial evidence suggests that they made up the bulk of relevant research underway at that time. For purposes of analysis they were divided into six categories:

Wide-scope Assessments	- nine studies	- Criteria: Open-ended consideration of possible impacts in several categories; multidisciplinary teams; the intention to support and influence public decisionmaking; a level of funding sufficient for in-depth examination.
Partial Assessments	- forty studies	- Criteria: Consideration of preselected secondary consequences in one or more categories.
Problem-Oriented Assessments	- fourteen studies	- Criteria: Focus on a societal problem to which technology is a contributor or a possible solution.
Environmental Impact Statements	- fourteen studies	- Criteria: Required by the National Environmental Policy Act of 1969, and offered by an agency as an example of technology assessment. These are treated separately from other partial assessments.
Futures Studies	- seventeen studies	- Criteria: Dealt with trends affecting future utilization and development of technology -- supply/demand studies, technological forecasts, long range planning studies.
Miscellaneous	- three studies	- Criteria: Two technology assessment methodologies, one survey of technology assessments.

(a) Wide-Scope Technology Assessments

Initiation of broad policy research by an agency appears rare; the wide-scope technology assessments were almost all initiated by Congress or at a higher level of the Executive Office.

Research teams had an average of 4.5 disciplines per team. Physical scientists, economists, and social scientists were most frequently included. The study efforts took the form of interdisciplinary interaction of the team, using a variety of analytical techniques, and included field or on-site investigation in the case of specific projects. One study relied heavily on modeling and simulation, three provided for input from affected publics by hearings or surveys and one included a large program of origional research.

The average cost of these studies was $381,000. The mean cost was $149,000, there being a wide range of costs. Average elapsed time* was 16 months. This was somewhat shorter than the average elapsed time for partial assessments (wide-scope technology assessments generally constituted the entire workload of the research team during the time of the assignment, which was often not the case with partial assessments). The contention of many agency officials that wide-scope technology assessment was impractical because it would add greatly to the decisionmaking time, was not supported by the evidence of these studies.

There appeared to be a significant learning period in the

*From initiation of research to final report.

performance of wide-scope assessments; experience in performing wide-scope technology assessment would very likely shorten the average elapsed time for studies conducted by experienced teams or team members.

The most significant aspect of the wide-scope technology assessments was a greatly broadened or restructured analysis compared to that originally proposed for the study. This was a consequence of new information emerging in the course of the study. Unexpected potential impacts suggested new policy issues or alternative technological approaches for exploration.

Four kinds of recommendations were produced by these assessments:

-- New or altered research priorities,

-- Specific policy formulations,

-- Modification of accepted practices or projects,

-- Termination of projects.

Administrative changes or legislative actions appear to have resulted from all wide-scope assessments which had been available to decisionmakers for a period of months prior to this analysis. They ranged from "informal changes in practices" and "definite influence on the ordering of research priorities" to outright termination of two large projects.

(b) Narrow or Partial Technology Assessments

Partial technology assessments had usually been initiated by an agency, often as a result of unsolicited proposals. They were

performed or funded as part of the on-going substantive research effort or for purposes of agency programming and evaluation. Therefore they were less likely than wide-scope assessments to be directed toward a particular instance of decisionmaking or policy formulation.

Seventy-eight percent dealt with either one or two categories of impacts, most often economic impacts or enviroimmental impacts. [Environmental impact statements required under the National Environmental Policy Act are treated separately below.] Usually the impacts to be investigated were selected before the study began, i.e., the investigation was not open-ended. Economic impacts were analyzed in 55 percent of the partial assessments and environmental impacts in 38 percent. When social impacts were investigated, it was most often in terms of socio-economic changes such as migration of farm workers or "quality of life" (treated qualitatively).

The most frequently used mode of procedure was collection and analysis of existing data. Twenty-two percent of the studies included some input from affected publics, usually through questionnaires or interviews.

The research teams included an average of two disciplines per team. The most frequently used were economics and social sciences.

The average cost of partial assessments by university research groups was $85,000; the average for assessments by independent organizations was $139,000. No figures were available for those

performed in-house. University studies had an average cost per professional man/year expended which was little more than half of that for independent research groups, probably because graduate students were used in a professional capacity at low remuneration. No measure for comparison of quality was attempted in this study.

The average elapsed time for partial or narrow technology assessments was 18.5 months. For university efforts, average elapsed time was 13.5 months, for independent research organization studies it was 22.2 months.

(c) Problem-oriented Assessments

Three broad themes were found in this group of 14 studies: environmental and health problems, inadequate public services, and the probable need for federal regulation in new areas.

Problem-oriented assessments were initiated from outside the agency in nearly all cases, either by unsolicited proposals or as a result of requests from Congress, the Executive Office, or public or professional groups. This suggests that federal agencies rarely initiate exploratory investigation of societal problems.

Less than a third of the problem-oriented assessments appear to have resulted in traceable administrative or legislative action. These assessments began by conceptualizing a societal problem in which technology is a factor; to some extent they open up new areas and represent a preliminary evaluation of the

magnitude of a problem. Thus their influence may be slow to mature.

The average cost of the problem-oriented studies was $678,000. This is nearly twice the cost of wide-scope technology assessment. The relatively high cost is not fully explainable and may be spurious since cost figures were available for a relatively small number of studies. The average elapsed time was about the same as for partial assessments but teams were larger.

These studies were more multi-disciplinary than wide-scope assessments, with an average of 6.3 disciplines per team. Physical scientists, engineers, and economists were most often included. There were social scientists on only ten percent of the teams, although they were dealing with societal problems. One-third of problem-oriented assessments utilized panels of experts from outside the government, more than any other category of studies.

(d) Environmental Impact Statements

Environmental impact statements offered by agencies as examples of their assessment activity ranged from brief and cursory documents to elaborate research reports. All were classified as partial assessments since they dealt primarily with the physical environment but in some cases other impacts were discussed, such as effects on ethnic groups and communities.

One-half of the statements were the subject of considerable

public controversy. Two, and possibly a third, have been or will be the subject of law suits. Five of the fourteen were the subjects of public hearings. Thus these statements were far more likely than other partial assessments to enter the arena of public discussion.

Environmental impact statements probably cost less than other partial assessments. Since they were prepared within agencies, no cost figures were available. Officials estimated the costs as generally in the neighborhood of $15,000 to $50,000, on the basis of professional staff time. If the average level of effort is much lower, for example $10,000 or approximately 3 man/months, the annual cost (at a rate of 200 per month) is $24,000,000 or 600 man/years. This is probably a low figure, and moreover does not include the cost of multiple agency review.

Environmental impact statements are effective in forcing agencies to collect information necessary for technology assessment, in providing experience in multidisciplinary consideration of secondary consequences of actions and projects, and in providing a mechanism for public review of executive decisionmaking. The National Environmental Policy Act thus created and maintains a strong stimulus to the development of the technology assessment process in federal executive agencies.

(e) Futures Studies

Technology assessment necessitates and benefits from the further development of capability in futures research. Technology

assessments for governmental projects and programs must deal with potential or anticipated impacts. They must therefore consider the trends in technological invention and innovation, the possible changes in application and levels of utilization of technologies, and the possible social environments of the future within which the technology may be utilized.

Seventeen examples of the 97 collected were concerned primarily with trends influencing the future levels of utilization of technologies: they were supply/demand projections and extrapolations, technological forecasts, and long range planning studies looking to government-wide or agency programming needs.

Only one study attempted systematically to lay out alternative socio-political scenarios for the future. This study was concerned primarily not with the social utility of a technology but with planning agency strategy to insure acceptance of its programs; it was therefore promotional rather than assessment-oriented in its intent.

The three technological forecasts were initiated by agencies to help with planning research programs or future regulatory trends; they were performed by contractors. As has been noted, civilian agencies tend to lack capability in technological forecasting. These three studies cost an average of $140,000.

Supply and demand studies and long-range planning studies were intended to explore the need for new federal policies, or to support agency planning and programming. Three were requested

by Congress or the Executive Office, eleven were initiated by agency personnel. About half were performed in-house and half by contractors. Estimates of cost are difficult since so many were performed in-house. Four supply and demand studies for which estimates are available had an average estimated cost of $743,000, higher than that for any other category, but because of the small number this figure should be treated with caution.

A variety of analytical techniques was used in futures studies, including modeling and simulation, trend projection and extrapolation, surveys, Delphi techniques, economic analysis, and reliance on concensus of experts. A majority of studies relied on one or two of these methods, mathematical modeling and consensus of experts being the most frequently used. Only one study combined as many as four techniques.

Futures studies were not strongly multi-disciplinary; an average of 2.1 disciplines was used, engineering and economics being the most frequent. Most of the studies concentrated on one trend or subject area such as materials supply and demand, economic projections, or a pattern of technological development.

(f) Miscellaneous Studies

Two studies, one by the Water Resources Council and one by a contractor for OST, were attempts to formulate methodologies for assessment. Both codified approaches which are already in use and neither produced innovative techniques qualitatively different from present assessment procedures. Their usefulness lies in

providing systematic elucidation of the steps in analysis for researchers who have not had experience in technology assessment. The Water Resources study also included testing by a number of assessment teams of the proposed procedures, allowing for some experimentation in applying such procedures in a field situation. The variations which resulted suggest that the proposed assessment procedures will give results which are not strictly reproducible but which are comparable, useful, and defensible for decisionmakers.

The final study was a survey of current technological activity in the federal, state, local, institutional, and industrial sectors. These findings have not yet been released.

Gaps and Overlaps in Federal Technology Assessment

Technology assessment in federal executive agencies (in the civilian sector) is chiefly concerned with:

- -- technology related to basic human needs: food and fibre technology, housing technology, biomedical technology, water resource technology;
- -- technology critical to an industrial society: power technology, mineral resource technology, transportation and communications technology;
- -- technologies over which the federal government exercises a unique degree of control, largely because of astronomically high costs of research and development and their derivation from early military applications: space and nuclear power technology.

All of these technology assessment areas were covered by the present study with the exception of communications technology;

because of a series of reorganizations and institutional changes which were going on during the period of this study, communications was not well covered, except for the activity of the U.S. Postal Service. This area of federal technology assessment needs further attention and description.

In space and nuclear technology, NASA and AEC are in a unique position to control the development of technology from basic research to final application and utilization. These agencies therefore have a unique responsibility for, and opportunity for, technology assessment. Both have in the past largely ignored this responsibility and opportunity. Both agencies interpreted their mandate as chiefly promotional. AEC's statutory charter for regulatory activities was written narrowly; the narrow regulatory power was carried over to the development activities as a justification for non-attention to potential detrimental impacts of technological development. Under the pressure of judicial interpretation of the National Environmental Policy Act in the Calvert Cliffs case, AEC has publicly signified its intention of reconstituting its planning and evaluation procedures.

NASA has not only failed to develop a capability for technology assessment but has consistently taken an aggressively promotional stance toward the technology which after all provides its *raison d'etre*. Even the "benefits studies" which NASA sponsors or performs to display the spin-off of benefits from space activity

to the civilian sector, have taken second place to the glamour of manned space flight in NASA justification of its programs, and secondary benefits and costs have not been thoroughly assessed from the standpoint of determining the appropriate postion of space programs in national priorities.

Food and fibre technology assessment is centered in the Department of Agriculture. The Department produces a large volume of partial or narrow assessments of high quality, usually concerned with economic, and more recently environmental, impacts. It tends to avoid, ignore, or suppress assessments dealing with controversial or sensitive social changes. In other areas of technology, the lack of a single agency with clear responsibility for planning and evaluating technological developments over a wide area of concern contributes to a paucity of wide-scope assessment. In agriculture, however, the chief factors are fear of constituency pressure and congressional reaction, stemming from the incompatibility of two primary Departmental mandates: service to industrialized agriculture and protection of the small farmer.

Successive waves of agricultural technology development have generated serious social problems as well as world-wide benefits: the mechanization of farming, the development of chemical fertilizers and pesticides, and the change in ownership and management farming. These changes, and trends such as production of synthetic fibres, integration of chicken and livestock farming,

and the advent of frozen foods, occurred without comprehensive anticipatory assessment which might have allowed alleviation of resulting dislocations.

New developments for which assessment is urgently needed are biological pesticides, fabrication of structured proteins, integration of pork farming, automated underground irrigation, and controlled environment farming.

Housing technology is perhaps the least adequately assessed of major technologies. Federal involvement in this area was relatively late. The housing industry is highly fragmented, reflecting the fragmentation of the market and the lack of industrialization of the industry. Federal policies such as post-World War II veterans' mortgages have had a tremendous impact on urban-suburban development without benefit of anticipatory assessment. The Department of Housing and Urban Development views provision of additional housing and stabilization of costs as an urgent and critical problem and therefore puts emphasis on action programs rather than evaluative research. Continuation of current trends and preferences is assumed uncritically; there is little attention to new developments such as the movement toward communal living, delayed marriage, or smaller families. Some assessment of new materials and building procedures and industrialized housing is performed, but most evaluation is limited to performance characteristics. The view of housing needs as an impending crisis impedes the development of technology assessment in HUD.

<u>Biomedical technology assessment</u> is located in several federal agencies such as NIH, NIMH, and FDA. They all take a narrow view of technology assessment, concerning themselves almost entirely with the safety and efficacy to the individual recipient of drugs and medical devices, and to a lesser extent with costs of delivery and impact on medical training and practice. Consequences of biomedical technology to the public or society at large and consideration of wider public issues are not found to a great extent. In large part <u>the explanation for lack of comprehensive assessment of biomedical technology is the prevailing American view of the private and privileged relationship between doctor and patient, which is rigorously defended by the medical profession against interference by public authorities</u>.

Recent advances in biomedical technology such as new contraceptives, behavior modifying drugs and techniques, organ transplants, genetic manipulation and laboratory conception, have ethical and public policy implications which make broader technology an urgent need. The National Science Foundation through its RANN Program (Research Applied to National Needs), has initiated some assessments in this area. NIH and NIMH have sponsored some wide scope technology assessments, usually by scientific advisory committees, but these tend to avoid defining options or addressing policy issues.

FDA, like other regulatory agencies, has a statutory charter which gives it little discretionary authority in evaluating new

drugs and medical devices. Within this context FDA interprets its authority as narrowly as possible and tends to resist extensions of its responsibility.

Assessment of water resource projects and technology is highly important for a number of reasons:

-- Water resource projects constructed with federal funds may affect many communities in several states or impact on an entire region,

-- Water resource projects create both public and private goods,

-- They require large capital investments,

-- They need long lead-times for planning and construction, and

-- They make large-scale, permanent changes in the physical environment.

There is a long history of federal involvement in water resource projects and at least six federal agencies have major responsibilities.

The major constraints on assessment of water resource programs and projects are institutional (the need to maintain and expand agency programs and funding) and political (the actions of congressmen in seeking new projects for their districts, and in responding to constituency pressures in favor of maintaining the status quo).

In water resource technology assessment, however, the process has been broadened and improved over the last five years, largely to meet the demands posed by the environmental movement and the passage of the National Environmental Policy Act. There is also

reason to suppose that the improvement will continue. In 1965 the Congress created the Water Resources Council which provides a mechanism for integrating technology assessments performed in federal agencies. This interagency organization has developed and tested new standards and criteria for water resource projects planning and evaluation, to be used by all agencies. While these by no means guarantee wide-impact assessment, they take into some account not only environmental concerns but social and community impacts, and must realistically be appraised as a long step forward over previous criteria.

In 1968 Congress also established the National Water Commission to provide an independent assessment of alternative national water policies (including interbasin transfers, which the Water Resources Council was statutorily forbidden to consider) and their economic, social, environmental, and aesthetic consequences. Thus there is now both a mechanism for integrating agency technology assessments and a mechanism for providing an independent, non-agency, assessment of federal water resource projects, programs, and policies.

Power generation and transmission technology assessment is important for reasons similar to those operating in the field of water resource technology: a long history of federal involvement, multi-state or regional impacts, large capital investment, creation of public and private sector goods, significant changes imposed on the natural environment, and the existence of federal

regulatory responsibility. The private sector power industry is large and fragmented, and makes relatively little investment in research. Demand for power is rapidly rising, while at the same time it is becoming difficult to find acceptable sites for new power plants because of competitive demands for land near large bodies of water and because of the opposition of environmentalists. Application of nuclear technology to power generation and two problems associated with this innovation (thermal pollution and alleged radiation hazards) have contributed a new factor to severe problems of public acceptance.

A comprehensive technology assessment which considers all of the implications of a power-intensive society is urgently needed. Although technology assessments of power projects are performed by a number of agencies, and power generation is a factor in virtually all assessments of water resource projects, no one agency appears to have the motivation, resources, comprehensiveness, and responsibility to perform an overall assessment of this kind. Such an effort might well be sponsored by the Office of Emergency Preparedness, the Office of Science and Technology, or the National Science Foundation; this will probably require initiation by a mandate from the President or at the request of Congress.

More research is also needed to identify new sources of energy and to assess these alternatives. While the National Science Foundation's RANN Program has identified this as one of its

program areas, most attention has been given to hardware research and very little so far to assessment.

Mineral resource technology is also an area where federal responsibility is fragmented. Several offices within the Department of Interior are concerned with mineral resources located in the public domain (about one-third of the U.S. land area). The Bureau of Mines is responsible for mineral conservation, environmental problems, technological development, and health and safety regulation. Interior also has ecological and conservation responsibilities, and this dual mission creates internal pressures on departmental assessors. The petroleum and coal-mining industries are reported by some observers to be able to successfully bring pressure to bear on technology assessors; substantiation of this charge is beyond the scope of this study.

The amount of federal technology assessment activity in the area of mineral resource extraction is very low. This may reflect the relative importance of the states in this area, and the influence and power of the minerals industry vis-a-vis its regulators. In view of the size and economic power of these industries, the critical importance of mineral resources to the nation, and the environmental damage associated with many kinds of minerals extraction, more assessment is badly needed. This is particularly true of strip mining, off-shore drilling for petroleum and transmission of petroleum by sea and pipeline.

No single agency has cognizance over a single mineral or source

or over mineral extraction technology. An integrating mechanism for performing comprehensive technology assessment in the minerals extraction area is badly needed.

Transportation is a critical technology in the United States because of the very large land area, a geographically dispersed population, and a highly integrated industrialized economy. Although state and local policies have strong influence on transportation, the Interstate Commerce Clause has given the federal government a dominant role in transportation planning when it chooses to exercise that role. Highway, rail, air, water and urban mass transportation systems are affected differently by a welter of federal, state, and local policies and actions, such as taxes, user charges, safety regulation, capital charges, and planning activity. The result is a serious imbalance between modes, with nonproductive competition and uneconomic duplication of facilities and routes in some areas and a lack of any service in others.

Until 1966 federal planning, promotion, and regulation of transportation was also on a modal basis and dispersed between a number of agencies and commissions. In 1966 most promotional and safety regulation responsibilities were given to the newly created Department of Transportation. To a greater extent than is typical of other federal agencies, DOT officials profess to have responsibility for, interest in, and enthusiasm for the development of technology assessment capability. The establishment

of DOT is beginning to pay off in a strong effort to develop a planning, analysis, and evaluation process directed toward the creation of a national transportation system.

There are great obstacles to this development both internally and externally. Internally, the obstacles are a scarcity of funds for intermodal technology assessment, but even more importantly, the lack of coordination and cooperation between the constituent modal administrations and between the modal administrations and departmental planners. Externally, the obstacles are legislation which freezes inflexible relationships and competition, and the Highway Trust Fund which stabilizes past inequities.

The record of the Federal Aviation Administration in technology assessment is poor. Although it cooperated in a recent DOT-NASA civil aviation policy study which recommended greater attention to social science analysis in research, including social impact analysis, FAA continues to adopt a promotional stance toward new air systems and airports. FAA officials claim no responsibility for or interest in broadening their assessment process. A few FAA officials expect this attitude to change rapidly under pressure from DOT and Congress. The change is not yet apparent.

The Federal Highway Administration (FHWA) is displaying new interest in social and environmental impact studies, although it is not yet clear to what extent these will be integrated into decisionmaking. Highway transportation enjoys the benefits of

the Highway Trust Fund and the political protection of an allegedly powerful highway lobby. Assessment in FHWA has suffered from this political pressure and that which arises from State Highway Departments. But public controversy over urban segments of the Interstate and Defense Highway System begun in 1956 caused costly delays and forced some improvement in the planning process. The first congressional response, a requirement for comprehensive metropolitan planning written into the 1962 Highway Act, helped to rationalize regional highway planning but also created a gap between regional highway planners and local decisionmakers in which social impacts of highway location was largely ignored.

Public reaction to community disruption and massive relocation built up, and concern for the natural environment provided additional pressure. Congress added, in successive highway legislation during the 1960's, requirements for consideration of environmental and social impacts, new restrictions on relocation, and a requirement for consultation with other agencies. Under these pressures the FHWA which had sponsored some environmental and social impact studies (and collected large numbers of those done by states and universities) over a period of two decades, has greatly expanded this activity and provided additional guidelines for state and local planners.

<u>The Federal Railroad Administration has begun preparations for several large wide impact technology assessments</u>. Until 1971

FRA had little or no money for social impact research. With American railroads approaching a state of crisis, Congress has provided more funds and expanded FRA responsibilities in the areas of safety, efficiency, and environmental considerations. FRA is now planning technology assessments of relocation of rail facilities in rail-locked communities, of alternative safety devices for rail crossings, and of extension of the Alaska Railway. Plans for these studies are couched in technology assessment terminology and indicate a comprehensive study plan but serious constraints of timing and funding.

Urban mass transit, until recently the step-child of federal transportation planning and funding, is now given "highest priority" by DOT. Until recently, the Urban Mass Transportation Administration regarded its primary mission as that of subsidizing local transit system development. While capital grants is still the primary thrust, there is now a policy that local projects should provide test cases for development of innovative approaches which have general applicability in other urban areas. UMTA displays something of the same crisis mentality shown by HUD in housing; since urban transit is an urgent need, emphasis is put on action programs, rather than on evaluation of social impacts of alternative solutions.

Prerequisites for Further Improvement of Governmental Technology Assessment

Futures Research must be upgraded and emphasized to allow improved forecasting of technological innovation and application, improved anticipation of possible impacts, and improved understanding of the alternative social contexts in which these trends may be experienced.

Current practices reinforce shortsightedness. When cumulative detrimental impacts reach serious proportions, or when the need for new technology or for technological solutions to societal problems is perceived as critical or urgent, action programs are emphasized. The evaluation of the potential social impacts of alternative solutions is downplayed or avoided lest it delay or interfere with immediate solutions. Urgent priorities and the demand for fast solutions constrain time, money, and personnel for foresight. More reliable and comprehensive forecasting techniques may help avoid such situations by anticipating problems before they become urgent and encourage alternative technological plans in advance of immediate needs. However, it appears that agencies will allocate sufficient funds and expertise to long-range planning and forecasting only if they receive a strong directive to do so from the Administration or from Congress.

Further major developments in technology assessment methodology will come from experience and experimentation to performing

technology assessment: the sponsoring of comprehensive technology assessments should not be contingent upon the general acceptance of systematic or elegant scientific methodologies. The development of an exhaustive and universally accepted list of social indicators, and the working out of quantifiable relationships between technological applications, impacts, and processes of social change is desirable. Development of technology assessment as an integral part of planning and evaluation of technological projects and programs can proceed without standardization of procedures if there is a strong and continuing demand from Congress or from the President through the Office of Management and Budget.

The demand for technology assessment from the agencies should be substantive rather than procedural. Institutionalization of technology assessment on the model of the filing of environmental impact statements is not desirable. It is likely that formal procedures such as the filing of technology assessment statements would quickly degenerate into a procedural requirement to be satisfied at the lowest possible level of effort, and by adding greatly to the workload of the agencies would absorb resources and time better spent on high priority projects and anticipatory, long-range assessments.

In some areas, particularly housing, biomedical, space, mass transportation, and mineral resource extraction technologies, immediate and significant increase in volume, as well as the

quality, of technology assessments is necessary. The pressing need for more housing and more urban mass transportation, the rapid development of biomedical science, and the uncritical attitudes and policies of NASA and of agencies promoting mineral resource development, have resulted in serious gaps in governmental technology assessment. These gaps can be corrected if Congress and the Office of Management and Budget provide both the requirement and the resources for improvement of the planning and evaluation process within existing agencies.

In other areas, interagency organizations are needed to collect, compare, weigh, and integrate technology assessments for the use of decisionmakers. For technologies such as power and chemicals (pesticides, fertilizers, and food additives), where a number of agencies share responsibilities, each agency has a narrow mission or a specialized constituency. Partial assessments are conducted by various agencies but none is balanced and comprehensive.

The report of the National Academy of Public Administration (A Technology Assessment System for the Executive Branch, 1970) recommended that the Council on Environmental Quality become the center for policy, monitoring, and review of technology assessment for the Executive Branch. This recommendation now appears ill-advised. The Council on Environmental Quality is within the Executive Office of the President. To expand its function to the extent necessary to monitor assessments from all agencies and to

improve the process substantively, would require resources and multidisciplinary personnel far in excess of what is appropriate for an office in that locus. As it presently operates within a narrower range of responsibility, the Council's work is largely procedural. Broadening of the substantive responsibility of agencies as a result of the National Environmental Policy Act has come, and probably will continue to come, not because of pressure from the Council so much as from public pressure acting through Congress and the courts.

A better alternative is the creation of a small staff for each major area of technology, following the model of the Water Resources Council. A professional staff not under the direction of any single agency could collect, compare, and evaluate technology assessments performed by all agencies impinging on the technology, and from other assessment entities in the private sector, and could also suggest and sponsor other assessments which are needed.

Finally, a source of independent assessments is needed. In all areas of federal involvement with technology, performance of objective comprehensive technology assessments is constrained by the demands of institutional protection. Agency performance is judged in terms of the volume of successful projects and programs and in terms of growth of appropriations and personnel. The success of programs and projects is generally judged in terms of planned or intentional performance rather than in terms of

second or third order effects which show up later and are sometimes difficult to relate to specific decisions or programs. These factors make inevitable some agency bias. Therefore a source of independent assessments should also be provided.

This function is best served by an organization which has no responsibility either for the projects and programs being assessed, or for avoiding or correcting their possible consequences. An agency which funds research but which has no line responsibility is in the most appropriate situation to sponsor independent technology assessments and to make these available to the Executive, the Legislature, and the public. Technology assessments sponsored in this way can cut across agency missions and can be consucted at any stage of development, including the critical anticipatory stage. They can potentially be given maximum exposure for all elements of the public decisionmaking process.

In order to achieve these two advantages fully, however, three things are necessary. The first is a system of publication and dissemination of assessment results so they reach the public and decisionmakers quickly, and in a readable and usable form. Most research-funding agencies have not yet developed such dissemination systems. The second necessity is for congressional funding which is both ample and sustained. The third requisite is that the management of the sponsoring agency adopt and maintain an attitude toward assessment needs which is fiercely independent, daring, and farsighted.

RECOMMENDATIONS

I. More attention to anticipatory assessment and long-range planning must be demanded from all agencies. Congress and the Executive Office (especially OMB) should provide additional resources and strong directives for expanded futures research, including technological forecasting, technology assessment, and social forecasting.

II. Emphasis on performance of technology assessment should not wait upon the development and acceptance of systematic methodology. Federal executive agencies are now in a position to perform and use technology assessment, and further methodological development should and will come from experience and experimentation in conducting technology assessment.

III. Strong and continuing pressure from Congress and from the Office of Management and Budget will be necessary to overcome built-in institutional inertia and ensure that federal agencies continue to improve and broaden the planning and evaluative procedures for technological projects. OMB should take steps to provide this pressure.

IV. The demands made by the Office of Management and Budget and the Congress should be substantive but not procedural. Formal requirements for technology assessment statements

on the modal of environmental impact statements are not desirable.

V. Pressure for a greatly expanded volume of technology assessment is especially needed in housing technology, biomedical technology, space technology, mass transportation technology, and mineral resource extraction technology.

VI. New organizations with small professional staffs should be provided for certain major areas of technology where many federal agencies have partial, overlapping, or conflicting responsibilities, such as power generation, chemicals, and biomedical technology. The function of these offices, following the model of the Water Resources Council, would be to collect, compare, weigh, and integrate technology assessments from the public and private sectors.

VII. A source of independent technology assessments should be provided. Maximum objectivity and usefulness to public decisionmakers can be achieved if assessments are sponsored by a federal entity having no responsibility for the project or program to be assessed, and are conducted by independent research organizations or university research groups.

VIII. An agency which funds research but which has no line responsibility can best provide this source of independent assessments. Such agency must develop a system for

publication and dissemination of assessment results to decisionmakers and to the public in a speedy and usable form. Funding for this agency must be ample and sustained.

IX. An immediate research effort should be undertaken to identify possible future innovations and inventions which need assessment. The National Science Foundation should sponsor a national survey of industry, research centers and government sources, aimed at identifying technology assessments which should be undertaken at once (some of which have been pinpointed through the present study). These would include recent and imminent developments in the experimental sciences, and also areas in which dramatic changes in level of application or utilization of existing technology are occurring or are likely to occur. The study should also include a large-scale effort in technological forecasting to anticipate developmental trends which have not yet become apparent. The fruitful approach to societal problems arising from technology is not alleviation but anticipation and avoidance.

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III. INSTITUTIONALIZATION OF TECHNOLOGY ASSESSMENT

E. Candidates and Priorities for Technology Assessments: A Survey of Federal Executive Agency Professionals

Howard C. REESE, P.I.

July 1973, pp. 1-18

I. EXECUTIVE SUMMARY

Background

The National Science Foundation requested the Program of Policy Studies in Science and Technology of the George Washington University to provide a list of candidates for technology assessment as proposed by high-level Federal executives. The purpose of the list would be to assist NSF in its role of supporting planning and assessment activities in and out of government.

The task was to result in four items:

- A list of subjects which survey participants suggested needed technology assessment together with an indication of the frequency of each subject mentioned;
- Suggested criteria for categorization of subjects for assessment;
- A preliminary evaluation of the urgency and of the significance of each candidate based on responses obtained by the survey; and
- Levels of government and agency location for recommended technology assessments.

Discussion

The study is an informational instrument and an educational tool. Used as a conventional data-gathering device, there are specific questions to be posed and answered. Less obvious but no less significant, a survey has a corollary aim of conveying knowledge about the subject on which opinions are sought. The study was based on mail questionnaires and face to face interviews. These two modes served the dual purpose of seeking necessary information and of educating the participants on technology assessment.

The survey offered the participants an opportunity to reflect on technological developments that warranted technology assessment, and provided a framework in which they should be considered. Which of these developments are in limited use? When would others achieve general or widespread use? What would be the social benefits or costs and what would be the scope in worldwide, national, regional, State, and local terms? On which groups, professional, industrial, geographical would the technological developments impact? By way of summing up, which agencies would have residual responsibility for technology assessments, and under what heading, research, regulation, enforcement, or funding would this accountability be exercised?

Methodology

The methodology consisted of a mailout of 206 questionnaires to officials in 24 Federal agencies and 54 interviews held in nine. It was necessary to identify a participant population, to design the questionnaire, to classify the technologies, and to analyze the data received quantitatively and qualitatively.

Classification of the nominees for technology assessment produced a three-by-three matrix with one dimension consisting of *physical*, *biological*, and *social* rows, and the other *problem*, *technology*, and *project* columns. Nominated technologies were assigned to one of the nine cells of that matrix.

Conclusions

In general, it can be concluded that social impacts are less fully understood than their physical counterparts for at least two reasons. One, social impacts are less susceptible to detection and to quantification, nor are there precise legislative requirements to report them. Two, there are fewer social scientists as compared to physical scientists in most Federal agencies. Despite these conditions, it is encouraging to note that anticipation of social impacts occurred as often as indicated. More specifically:

1. Some subject areas for technology assessment were proposed 20 or more times:
   - transportation,
   - energy,
   - management,
   - automation and computers,
   - communications,
   - resource use,
   - health care,
   - policy,
   - education.

2. Respondents indicated that 78.7 percent of the technological developments proposed for assessment were already in limited use, 17.2 percent in general use, and 4.1 percent in widespread use.

3. The periods of time in which proposed technological developments were anticipated to achieve general use were:

a. Ten percent in one to two years;

b. Less than 23 percent in two to four years;

c. Nearly 28 percent in four to eight years;

d. The remainder in over eight years.

The periods of time for technological developments to attain widespread usage were:

a. More than eight years, the majority (60 percent);

b. Four to eight years (20 percent);

c. Four years (14 percent); and

d. The period 1973-75, less than six percent.

4. Most important impact areas to assess:

Environmental impacts received double the number of entries as those noted for social impacts.

5. The scope of impacts attributed to technological developments rated "most important," "next most important," and "third most important," was:

a. Worldwide effect (42.8 percent)

b. National impact (41.2 percent)

c. Regional impacts (6 percent) (State and local)

6. Groups impacted:

Respondents tended to use general inclusive terms such as "all," "many," "society," or "the general public." More limited groups (e.g., agriculture, taxpayers, scientists or specific industrial groups) were also cited at times but it was noted that affected groups were often thought of as institutions (banks, the schools and universities) or occupations (scientists, retailers, farm workers) rather than in socioeconomic or physical terms (poor, the undereducated, the handicapped, the aged).

7. Type of impact:

The technologies rated as "harmful" or "very harmful" showed no pattern of concentration, and in fact were often the same technological developments rated by others as beneficial or very beneficial. Virtually without exception, developments rated "harmful" were already in use. Either widespread faith in progress, or a lack of discrimination appears indicated in that individuals depicted their nominees as "very beneficial" in overall impact in 38 percent of citations.

8. Preliminary evaluation of the urgency and the significance of selected subjects for technology assessment:

Because of the low number of entries in the category that could be taken to be an urgent and significant category for technology assessment, that is, the *very harmful* category, and the cluster of entries in the *very beneficial* and in the *beneficial* categories, it is difficult to draw definite conclusions regarding the urgency and significance of selected subjects for Technology Assessment. (See Tables 4 and 5.)

9. Levels of government and agency location for technological responsibilities:

Survey participants most often indicated Federal agencies as having primary concern for technology developments with State governments second. Within the Federal framework, the Environmental Protection Agency was most often cited as the agency which should have responsibility. Research, in contrast to enforcement or regulation, was most often given as the area of responsibility.

10. In general technologies should be assessed by more than one institution. Federal agencies were recommended 153 times, the Congress 91 times, State government 50 times, local government 40 times, industry 19 times, international organizations seven times, and universities eight times. Numerous other groups were mentioned.

II. TECHNOLOGY ASSESSESSMENT

The Purposes of Technology Assessment

Technology, it can be said, is the imposition of change on a product, process, institution or relationship, usually for the purpose of improvement and progress, and also usually with some real or imagined rational justification.

Postindustrial (or technological) man has learned that changing a single element of a complex and poorly understood system usually produces unexpected, and often highly undesirable results in addition to the intended improvement. Because of this, he has devised yet another technology, that of examining changes to ascertain as best he can all of the substantial effects. To ascertain all the substantial effects of a change, past, current, future, is the purpose of technology assessment.

By examining past changes, technology assessment can learn how seemingly wholly desirable technological impositions have resulted in unintended, unexpected and undesirable impacts. This is instructive, both as to how indirect and downstream impacts occur, and how they can be anticipated by technology assessment.

By examining changes which are still underway, technology assessment can discover undetected or hidden impacts. With this information, attempts can be made to avoid, to modify or to enhance, as appropriate, the previously hidden impacts, or to modify the basic change itself based on a careful consideration of all of the significant impacts involved, rather than on the one that inspired the change in the first place.

By examining possible future changes, technology assessment attempts to provide policy makers with better data and analyses for making policy decisions. As with most forecasting exercises, the results will seldom achieve perfection, but the effort will result in a more rational and effective policy decision process.

The Significance of Technology Assessment

Technology assessment is significant for at least three equally important reasons.

First, technology assessment is the use of systematic methods to examine applications of science and technology.

Second, when man's ability to alter his environment was puny and his alterations were small and temporary, it was worth little to foretell all of the effects of those changes because both changes and effects soon passed. Now, however, changes are large, impacts are massive, and moreover may be irrevocably disastrous.

Third, in a modern democratic society, accurate, disinterested, and complete knowledge is essential for viable operation. Not to provide that information subverts the intent of democracy. Lacking such knowledge, power moves from the people to those special interests which, seeking their own narrow goals, are not likely to search for reasons to oppose them. The interests of those who may be adversely affected are thereby usually ignored until too late. Technology assessment is, therefore, significant in at least three principal ways: scientific, democratic, and human survival.

Technology assessment is significant in still another way, social justice. For example, why should all the downstream users of a stream suffer loss of that use to provide a free sewer for an upstream user? Not all technological changes are so clear cut, yet there *are* always beneficiaries and "disbeneficiaries." In the realm of conflicting values, an ethical society is interested in equity. Technology assessment is a means of deciding the relative costs and benefits to each of those affected by a technological change. In that way the equity of the proposed change can be determined. Certainly technology assessment itself does not determine the equity, nor should it try. But it does provide an essential ingredient for such a determination.

If scientific data and analysis is not used in making equity decisions, such decisions become guesses, blind chance, or responses to hidden biases and pressures.

Table 1 shows the complete list of 457 technologies nominated by participants in the study. Since many were nominated more than once, 382 candidates for technology assessment result from the questionnaires

and from the interviews. Nominees are organized according to the source of interest – a technology, a problem, or a project, and by the kind of technology – physical, biological, or social (See Figure 1). The cells are designated by letters for convenience in presenting the material in Table 1, i.e., the contents of each cell.

A more detailed discussion of this taxonomy will be found in Appendix D.

The material in Table 1 was further organized into 31 subcategories. Their distribution in relation to the matrix is shown in Figure 2.

FIGURE I – Classification of Technology Assessments

	Origin		
Technologies	*Problem*	*Technology*	*Project*
Physical	A_1	A_2	A_3
Biological	B_1	B_2	B_3
Social	C_1	C_2	C_3

Thirty-one subcategories were used to group all T.A. candidates. All candidates were assigned to a subcategory, but not all subcategories were represented in each cell of the matrix.

FIGURE 2 — Nominees by Subcategories

Subcategories	*Matrix Cells*									
	A,1	*A,2*	*A,3*	*B,1*	*B,2*	*B,3*	*C,1*	*C,2*	*C,3*	*Total*
1. Transportation	10	47	11					2		71
2. Management		1	1			1	15	11	6	35
3. Energy	13	19					1			33
4. Communications	2	12	13				1			28
5. Computers/Automation	1	9	4		1		5	5	3	28
6. Resource Use	4	9	4				6	1	3	27
7. Health Care	2		2	5	6	2		3	6	26
8. Policy							10	4	7	21
9. Education							7	10	3	20
10. Pollution	6	9	2							17
11. Community Development			2				10	2	2	16
12. Economics							5	5	5	15
13. Public Safety							4	4	5	13
14. Politics							6	3	3	12
15. Weather Modification	8	4								12
16. Nuclear Technology	1	8	1							10
17. Space/Satellites	1	5	4							10
18. Agriculture	1	1	3		1	2				8
19. Water	3	4	1							8
20. Mental Health							6	1		7
21. Resource Conservation	3					1	3			7
22. Sociology							1		6	7
23. Electronics		6								6
24. Biology				1	2					3
25. Birth Control				1	2					3
26. Nutrition				1	2					3
27. Consumer Behavior					1			1	1	3
28. Disaster Planning	2	1								3
29. Construction	1		1							2
30. Industrial Production	1	1								2
31. Cartography			1							1
TOTAL	58	136	51	8	15	6	80	51	52	457

Matrix Cell Codes

A,1 Physical-Problem (11)
A,2 Physical-Technology (12)
A,3 Physical-Project (13)
B,1 Biological-Problem (21)
B,2 Biological-Technology (22)
B,3 Biological-Project (23)
C,1 Social-Problem (31)
C,2 Social-Technology (52)
C,3 Social-Project (33)

III. ANALYSIS

The proposal set forth four main objectives for the study:

1. To suggest criteria for categorization of subjects proposed for technology assessment;

2. To develop a list of technological developments for which Federal officials believe technology assessment is needed;

3. To provide some preliminary evaluation of the urgency and the significance of the selected topics; and

4. To suggest levels of government and agency location for recommended technology assessments.

Possible Criteria for Categorization of Subjects for Technology Assessment

1. Time Span for the Technological Development

The survey approached the question of when assessment of a suggested invention, innovation, or application should be undertaken by asking two questions: whether the technology is in limited, general, or widespread use, and the period of time which the technological development would take to achieve general widespread use (see items 5 and 6 of the questionnaire, Appendix B). To provide the reader with an overview of the relative urgency of suggested assessments from the standpoint of judgments related to these two criteria, Tables 2 and 3 list these candidates in each developmental category.

Respondents indicated that 78.7 percent of the technological developments were already in limited use. Only 17.2 percent were reported as being in general use, and 4.1 percent in widespread use.

Of those T.A. candidates not now in use, barely 10 percent of the nominees were seen as achieving general use within one or two years, and slightly less than 23 percent in two or four years. Nearly 28 percent of the nominees were anticipated within four to eight years, and the remainder, 39 percent, in over eight years. In this category, some nominees were seen as requiring as much as about 20 years to achieve general usage,e.g., liquid sodium nuclear reactor (see Table 7, p. 26).*

The majority of the nominees, 60 percent, were placed in the category of requiring more than eight years to achieve widespread usage, e.g., dietary changes for prevention of arteriosclerosis (see Table 7, p. 35). Somewhat less than 20 percent were considered as taking four to eight years, e.g., breeder reactors (see Table 7, p. 37). Nearly 14 percent were thought to require four years, e.g., improved resolution for Earth Resources Technology Survey (ERTS) (see Table 7, p. 37), while fewer than six percent were expected to realize widespread use in the period 1973-75, e.g., the Marine Mammal Act (see Table 7, p. 30). Most respondents, it appears, took very seriously the anticipatory nature of technology assessment.

2. Nature, Scope, and Significance of Potential Impacts

The heart of the survey is to be found in the respondents' anticipation of potential impacts. Three of the eight criteria for categorization of subjects for technology assessment dealt with impacts. The survey handled references to impacts under five direct or corollary items of the questionnaire.

(a) *Most Important Impact Areas To Assess* (Questionnaire items 7a, 8a, 9a).

Sixty respondents indicated the impacts related to the environment as a necessary area for assessment, almost double the number of 35 that put forth social or sociological impacts for assessment (e.g., the displacement of people as a result of farm mechanization). Economic benefits-costs received 25 citations, and the cost-effectiveness of systems was mentioned 23 times.

Federal officials thus reflected recent public concern over environmental degradations and hazards to health and to safety. Many of the respondents have been involved in preparation or review of Environmental Impact Statements required under the National Environmental Policy Act of 1969, which has undoubtedly sensitized them to possible impacts on the physical environment.

*Table 7 is a summary of the raw data for the study.

Social impacts are more poorly understood, and at present less susceptible to detection and to quantification. Nor is there a systematic legislative requirement for their reporting. There are also relatively few social scientists, as compared to physical scientists, economists, and engineers in most Federal agencies.* Given these conditions, it is encouraging that anticipation of social impacts occurred as often as indicated.

(b) *Scope (Scale) of Impacts* (Questionnaire items 7b, 8b, 9b).

Eighty-four percent of the impacts identified as "most important," next most important, and third most important were depicted as having a worldwide effect (42.8 percent), or a national impact (41.2 percent). Nearly 11 percent were estimated to have regional impacts, and less than six percent to have consequences primarily for State and local areas (see Table 3). This may indicate that technology assessment will continue to be concentrated at the Federal government; but it should be noted that respondents in this survey were all Federal officials. They were also thinking primarily of technological developments at a fairly high level of abstraction. Increased funding for development of innovative energy technology, or national policy concerning water resources, for example, might best be assessed at a national level, while assessment of a particular power plant or dam might be an appropriate subject for local or regional level assessment.

(c) *Groups Impacted* (Questionnaire items 7c, 8c(1), 9c(1).

Respondents gave 807 responses identifying groups who would be affected by the potential technological developments. One hundred and five responses singled out "all," "many," or specific industrial groups as being affected by the technological development. Almost the same number (102) entries) pointed out "society" as being affected, and another 72 responses named the "general public," a subset of society. More limited groups (e.g., agriculture, taxpayers, scientists) were frequently mentioned, but it is noticeable that affected groups were more often thought of as institutions (banks, educational institutions) or occupations (scientists, retailers, agricultural workers) than in socioeconomic or physical terms (the poor, the undereducated, the handicapped, the aged).

(d) *Type of Impact* (Questionnaire items 7c, 8c(1), 9c(1).

A total of 753 different entries indicated the nature of an impact on specific groups (professional, industrial, geographical, and social). Forty-three impacts were specified as *very harmful*, and 170 as *harmful*. A much larger proportion, about one-third of the impacts, or 255, were depicted as *beneficial*, and nearly 38 percent, or 285, as *very beneficial*. (See Tables 4 and 7).

The technologies which *individuals* rated as harmful or very harmful showed no pattern of concentration, and in fact were often the same technological developments rated by others as beneficial or very beneficial (e.g., changes in work scheduling or retirement, air pollution controls on automobiles). Almost without exception, the developments rated harmful were either already in use (e.g., existing decision processes and criteria for land use, concentration of farming) or were expected to be in widespread use within the next four to ten years.

Either widespread faith in progress, or a lack of discrimination seems indicated by the fact that individuals rated their nominees as *very beneficial* in overall impact in 38 percent of the cases. Nominees called *very beneficial* covered a wide range, but were especially concentrated in telecommunications and information technology, transportation, energy generation and resources, environmental enhancement measures, and building materials and techniques. However, in nearly three out of four cases a technological development rated as *very beneficial* was also judged by the same individual to have significant disadvantages. Most often the disadvantages were problems of transition (obsolescence of existing technologies, need for new institutions), costs (either development and investment costs, or increased costs of a service to users), detriments to those with a vested interest in existing technologies which would be replaced, or possible environmental degradation. Concerning improved telecommunications and information technology, a threat to privacy was often cited as a significant disadvantage. As for innovative transportation, effects on urban land use and population distribution were often cited.

(e) *Principal Benefits (Planned and Unplanned) And Principal Disadvantages* (Questionnaire items 10(a)(b)(c).

Table 5 shows a selected listing of benefits and disadvantages that were associated with particular technological developments. (Table 7 gives the full display of

*In 86 Federal offices it was reported that social scientists (anthropologists, historians, political scientists, psychologists, and sociologists) make up 19 percent of the professional staffs. By contrast, engineers (54 percent), economists (46 percent), physical scientists (33 percent), biological and medical scientists (28 percent), and operations research analysts (21 percent) showed the disparity in emphasis. See Vary T. Coates, *Technology and Public Policy, The Process of Technology Assessment in the Federal Government*, I, p. 2-13.

benefits and disadvantages). Eighteen respondents cited improvement or enhancement of the enviroment as the principal planned benefit of individual technological developments.

Thirteen respondents identified environment improvement as the principal unplanned benefit resulting from their nominees for technology assessment; 15 respondents pointed to environmental damage as the major disadvantage of technological developments. Fourteen respondents referred to improvement in transportation systems, and 13 to the quality of life as the principal planned benefits.

3. Preliminary Evaluation of the Urgency and the Significance of Each Candidate

The survey used the distribution of the potential overall impacts and the order of subcategories of technological developments as a basis for determining a preliminary evaluation of the urgency and the significance of selected topics. The distribution of data, however, makes it difficult to draw definite conclusions.

It would appear logical to indicate a *very harmful* technological development would suggest categorization for preliminary evaluation and urgency. Yet only two nominees fell under this heading, the breeder reactor program and the present decision-making process and criteria for land use. Interestingly, one respondent reported this technological development as favorable. Out of 189 entries this amounted to only 1 percent. The *harmful* category, e.g., development of a hydrogen energy transport system, mobile homes as a way of life, and regulating use of farm chemicals to reduce pollution of streams and lakes furnished 17 entries, or 9 percent of the total.

By contrast, a cluster of entries appeared in the *very beneficial* and *beneficial* categories. In the first, e.g., videophone or televised closed-circuit conferences, remote-controlled railroad freight cars, ocean offshore breakwaters and islands, mining and processing shale for oil, individuals rated 80 of their nominees in this group (42 percent). In the second, e.g., improved resolutions of Earth Resources Technology Survey (ERTS) Cameras, environmental controls, impact of computer technology on the Federal bureaucracy, and technology for utilization of renewable energy resources, individuals scored 58 of their nominees (30 percent) fell with this group. On the basis of these contrasting potential overall impacts, it is difficult to be definitive about the urgency and significance of topics.

Nor is it less difficult to order technological developments according to subcategories. Candidates were grouped according to innovation or invention, and not by problem or impact. Yet it is possible to conclude that transportation within both dimensions of the matrix had a clear lead over the next subcategory, management (see Figure 2). More definitely established were agencies concerned and their types of responsibility.

4. Levels of Government and Agency Location for Responsibility over the Technology

With regard to technologies proposed for assessment, responsibility for research, enforcement, regulation, and other activities is seen as resting principally in Federal agencies. State governments were the second most frequent locus for those responsibilities (responses to question 3).

Within the Federal framework, the Environmental Protection Agency most often was cited as the place for these responsibilities (see Table 6).

Of 409 answers, 50 percent cited research as a prime responsibility. Twenty-eight percent cited regulation as the prime responsibility. The remainder were split between enforcement (13 percent) and "others" (10 percent).

5. Where Technology Assessment Should Be Conducted.

In response to question 12, 417 suggestions were made for where technology assessments should be conducted. There were as follows:

(5 specific agencies were cited 6 times)

Federal Agencies	153
Congress	91
State Governments	50
Local Governments	40
Industry	19
Universities	8
International Groups	7
Others	49

Others included non-profit groups, the National Academies, blue-ribbon commissions, and neighborhood and environmental groups.

Federal agencies and the Congress were frequently cited simultaneously, as were State and local government frequently cited along with the Federal government and the Congress.

The general impression is that more than one agency or institution should be assessing the candidates proposed.

TABLE 1 — List of Nominees and Candidates by Matrix Rows and Columns

Nominee	Nominee Count (Candidate Count): Questionnaire	Nominee Count (Candidate Count): Interview	Nominee Count (Candidate Count): Total
A. Physical 13.3%			
1. Problem			
a. Agriculture	(1) 1		(1) 1
(1) Concentration of Farming	1		
b. Communications		(1) 2	(1) 2
(1) General		(1) 2	
c. Computers/Automation		(1) 1	(1) 1
(1) Interconnected Data Systems		1	
d. Construction	(1) 1		(1) 1
(1) New Materials for Housing	1		
e. Disaster Planning		(2) 2	(2) 2
(1) Aircraft Disaster Provisions		1	
(2) Capability of U.S. Commercial Shipping in DOD Operations		1	
f. Energy	(6) 6	(2) 7	(8) 13
(1) General	1	(1) 5	
(2) New Sources of Energy	1		
(3) Increased Energy Consumption	1		
(4) Non-fossil Fuel Energy System	1		
(5) Renewable-energy Sources	1		
(6) Energy Planning		(1) 2	
(7) Energy Technologies	1		
g. Health Care		(2) 2	(2) 2
(1) Architectural Barriers for Handicapped		1	
(2) Design Standardization for Handicapped		1	
h. Nuclear Technology		(1) 1	(1) 1
(1) Nuclear Disaster Planning		1	
i. Pollution	(1) 2	(3) 4	(4) 6
(1) Noise Pollution	(1) 2		
(2) Effluent Waste Disposal		1	
(3) Solid Waste Disposal		(1) 2	
(4) Poison Gas Disposal		1	
j. Resource Conservation	(1) 1	(2) 2	(3) 3
(1) Natural Resource Conservation	1		
(2) Use of Waste Materials		1	
(3) The Finite Limits of Minerals and Fossil Fuels		1	
k. Resource Use	(1) 1	(3) 3	(4) 1
(1) Resources Depletion Problem		1	
(2) Use of Nominal Solid Waste for Road Construction Material	1		
(3) Sea Resource Extraction		1	
(4) Rising Costs of R&D		1	
l. Space/Satellites	(1) 1		(1) 1
(1) Space Program	1		
m. Transportation	(5) 6	(3) 4	(8) 10
(1) General		(1) 2	
(2) Auto & Highway Safety	1		
(3) Low-capital Alternatives	1		
(4) Public Transport of Handicapped	1		
(5) Urban Mass Transit Systems	1		
(6) Vehicular Moving Power	(1) 2		
(7) Propulsion		1	
(8) Integrated U.S. Transportation Plan		1	
n. Water		(2) 3	(2) 3
(1) Water Needs (Potable and Agricultural)		(1) 2	
(2) Runoff Problem		1	
o. Weather Modification	(1) 6	(1) 1	(2) 7
(1) General	6	2	
Subtotal	(18)25	(23)33	(39)58
2. Technology 36.7%			
a. Agriculture	(1) 1		(1) 1
(1) Agricultural Chemicals	1		
b. Communications	(5) 7	(4) 5	(9) 12

TABLE 1 – List of Nominees and Candidates by Matrix Rows and Columns – Continued

Nominee	Nominee Count (Candidate Count)		
	Questionnaire	*Interview*	*Total*
(1) Information/Communication Technologies	(1) 2		
(2) Communication – UHF/VHF/HF etc.	1		
(3) Broad-band Communications	(1) 2		
(4) Low-cost Communications	1		
(5) Interconnection of Computers/Satellites/Microwave Telephone Lines TV/CATV	1		
(6) Electromagnetic Spectrum Constraint		1	
(7) Teleprocessing (Infinite Capacity Cost Approaching Zero)		(1) 2	
(8) Network Concepts for Bulk Mail Processing		1	
(9) Land-mobile Telephone System (Phone in Cars)		1	
c. Computers/Automation	(3) 3	(4) 6	(7) 9
(1) Interconnected Computer Network		(1) 2	
(2) The Automation of Most Routine Functions		(1) 2	
(3) Automation of Dangerous Operations	1		
(4) Impact of Computer Technology on Federal Bureaucracy	1		
(5) Computer Technology	1		
(6) Computer Networks		1	
(7) Computers in Traffic Situations for Traffic Control		1	
d. Disaster Planning	(1) 1		(1) 1
(1) Earthquake Detection	1		
e. Electronics	(2) 2	(2) 4	(3) 6
(1) Lasers	1	(1) 3	
(2) The Transistor	1		
(3) Microwave		1	
f. Energy	(13) 14	(5) 5	(15) 19
(1) Coal as Interim Energy Source	1	1	
(2) Coal Gasification	(1) 2		
(3) Coal Liquefication	1		
(4) Mining & Processing Shale for Oil	1		
(5) Hydrogen as Major Energy Source	1	1	
(6) D.C. Electric Power Transmission	1		
(7) Megawatt Electrical Aesthetic Transmission	1		
(8) Liquid Natural Gas	1		
(9) Battery Research Leading to Electric Personal Cars	1		
(10) Temporary Storage of Heat in Underground Aquifers	1 1		
(11) Individual Home-Power Package	1		
(12) Development of Nuclear-based Electrical Energy Industry	1		
(13) Solar Heat	1	1	
(14) Electrical Motors		1	
(15) Electrostatic Energy as a Source of Power		1	
g. Industrial Production		(1) 1	(1) 1
(1) Standardization of Consumer Goods		1	
h. Management		(1) 1	(1) 1
(1) Impact of Environmental Controls. (Emission Devices) on Manpower Needs		1	
i. Nuclear Technology	(4) 6	(1) 2	(5) 8
(1) General	(1) 2		
(2) Liquid Sodium Nuclear Reactor	(1) 2		
(3) Breeder Reactors	1		

TABLE 1 – List of Nominees and Candidates by Matrix Rows and Columns – Continued

Nominee	Nominee Count (Candidate Count)		
	Questionnaire	*Interview*	*Total*
(4) Offshore Nuclear Plants		(1) 2	
(5) Controlled Fusion Reactor	1		
j. Pollution	(3) 7	(2) 2	(4) 9
(1) Air	(1) 3	1	
(2) Oil Spill Cleanup Device	1		
(3) Water	(1) 2	1	
(4) Improved Methods of Measuring Toxic Substances	1		
k. Resource Use	(2) 2	(7) 7	(9) 9
(1) Substitution of Wood Resources for Non-renewable Mineral Resources	1		
(2) Wood Waste as Power Source	1		
(3) Timber Production and Use		1	
(4) Renewable vs Non-renewable Materials for Construction		1	
(5) Sea Bed Resource Extraction		1	
(6) Uses for Waste Products - Containers with Secondary Uses		1	
(7) Re-use of Waste Water		1	
(8) Rising Costs of Weapon Systems		1	
(9) Increased Fuel Use Caused by Automobile Emission Controls		1	
l. Space/Satellites	(2) 3	(2) 2	(3) 5
(1) Satellite Communications	(1) 2	1	
(2) Direct Broadcast Satellites	1		
(3) Advanced Satellite Programs		1	
m. Transportation	(14)17	(24)30	(30)47
(1) Arctic Bulk Commodity System	1		
(2) Air Cushion Vehicle	1	(1) 2	
(3) Short-haul Air Transport	(1) 2	1	

Nominee	Nominee Count (Candidate Count)		
	Questionnaire	*Interview*	*Total*
(4) Guided Automatic Transport System	1		
(5) Catamarans		1	
(6) Great Lakes Water-borne Transportation System	1		
(7) Transportation of Hazardous Materials	1	(1) 2	
(8) Hydrofoil		1	
(9) Hydrogen Energy Transportation System	1		
(10) Integrated Domestic Transportation System		1	
(11) International Airlines		1	
(12) Merchant Ship Construction/Operation	1	(1) 2	
(13) Mobility		1	
(14) Automated-Vehicular Monitoring	1	1	
(15) Off Airport Passenger Handling Systems	(1) 2		
(16) Offshore Breakwaters & Islands	1	1	
(17) Railroad		1	
(18) Urban Mass Transport	1	(1) 4	
(19) Quiet VSTOL	1	1	
(20) Overwater Transportation	(1) 2		
(21) The Safety Car		1	
(22) Use of Salt for Snow Removal (on roads)		1	
(23) Dual-mode Transportation System		1	
(24) Transportation of Liquid Natural Gas		1	
(25) More Containers on RR, Fewer Boxcars		1	
(26) Integrated Transportation Planning		1	

TABLE 1 – List of Nominees and Candidates by Matrix Rows and Columns – Continued

Nominee	Nominee Count (Candidate Count) Questionnaire	Interview	Total
(27) Night Truck Delivery		1	
(28) Submarine Operations (Commercial)		1	
(29) Heat Pumps in Road Pavement to Prevent Freezing		1	
(30) Marine Structures as Units for Housing and Storage - Sewage Treatment Plants		1	
n. Water	(3) 4		(3) 4
(1) Water Augmentation Through Waste Reclamation	(1) 2		
(2) Desalinization of Sea Water	1		
(3) Water Recovery from Underground Rivers	1		
o. Weather Modification	(2) 2	(2) 2	(4) 4
(1) Long-term Weather Forecasting		1	
(2) Fog Modification	1		
(3) Precipitation Augmentation/Hail Suppression	1		
(4) Checking Tornadoes & Hurricanes		1	
Subtotal	(55)69	(45)67	(100)136
3. Project 17%			
a. Agriculture	(2) 2	(1) 1	
(1) Mechanization of Tobacco Production	1		
(2) Mechanical Harvesting of Citrus Crops	1	1	
b. Cartography	(1) 1		(1) 1
(1) Base-mapping Standardization	1		
c. Communications	(4) 5	(6) 8	(8) 13
(1) Wired City		(1) 2	
(2) Interactive Cable TV Systems	1		
(3) Open-broadcast Cable TV	(1) 2	1	
(4) Video Phone	1	1	
(5) Electrical Mail Processing		1	
(6) Transmission of Fingerprints		(1) 2	
(7) Fiber Optic Message Transmission	1		
(8) Replacement for Daily Newspaper		1	
d. Community Development		(2) 2	(2) 2
(1) Individual Burlar Alarms		1	
(2) 14-Foot Wide Mobile Homes		1	
e. Construction	(1) 1		(1) 1
(1) Insulation of Private Dwellings to Conserve Energy	1		
f. Computers/Automation	(2) 2	(2) 2	(4) 4
(1) Office Automation	1		
(2) Microfilm Storage Storage of Records	1		
(3) Invasion of Privacy by Interconnected Data Banks		1	
(4) Cost-benefit Analysis for ADP		1	
g. Health Care	(1) 1	(1) 1	(2) 2
(1) Drug Abuse Detection Techniques		1	
(2) Disposable Supplies for Hospitals	1		
h. Industrial Production	(1) 1		(1) 1
(1) Metal Forging, High Energy	1		
i. Management		(1) 1	(1) 1
(1) Work at Home Through Communication Hookup		1	
j. Nuclear Technology	(1) 1		(1) 1
(1) Breeder Reactor	1		
k. Pollution	(1) 1	(1) 1	(2) 2
(1) Removal of Stack Gases of Coal-fired Power Stations	1		
(2) Limiting Horsepower as a Means of Controlling Internal Combustion Pollution		1	

TABLE 1 — List of Nominees and Candidates by Matrix Rows and Columns — Continued

Nominee	Nominee Count (Candidate Count) Questionnaire	Interview	Total
l. Resource Use	(4) 4		(4) 4
(1) Recovery of Alumina for Domestic Raw Materials	1		
(2) Use of Sewage & Industrial Wastes	1		
(3) Use of Waste Wood for Structural Materials	1		
(4) Advanced Logging Systems	1		
m. Space/Satellites	(2) 4		(2) 4
(1) Earth Observation Satellites	(1) 3		
(2) Improved Resolution of ERTS Cameras	1		
n. Transportation	(6) 8	(3) 3	(8) 11
(1) Electric Cars	1		
(2) Remote Control for Railroad Freight Cars	1		
(3) Transport Wood Chips by Hydraulic Pipeline		1	
(4) Rapid Transit (Bus)	(1) 3	1	
(5) Magnetically Levitated Trains	1		
(6) Increased Use of Mass Transit	1		
(7) Dulles Proposal to Permit Access from Reston		1	
(8) Alaskan Pipeline		1	
o. Water	(1) 1		(1) 1
(1) Underwater Storage & Transport of Water in Low-Cost Storage Plastic Pipes	1		
Subtotal	(25)32	(16)19	(41)51
TOTAL	(98)126	(84)119	(182)245
B. Biological 1.6%			
1. Problem			
a. General		(1) 1	(1) 1
(1) Biomed. Advance		1	
b. Birth Control		(1) 1	(1) 1
(1) Zero Population Growth		1	
c. Health Care	(2) 3	(2) 2	(4) 5
(1) General		1	
(2) New Equipment for Medical Care	1		
(3) Cancer Cure	(1) 2		
(4) Zero Aging		1	
d. Nutrition		(1) 1	(1) 1
(1) Chemical Feast		1	
Subtotal	(2) 3	(5) 5	(7) 8
2. Project 2.1%			
a. Agriculture	(1) 1	(1) 1	(1) 2
(1) Minimum Tillage System	1	1	
b. Health Care	(1) 1	(1) 1	(2) 2
(1) Artificial Heart	1		
(2) Drug-Immunizing		1	
c. Management	(1) 1		(1) 1
(1) Centralized Radiation Level Record Keeping	1		
d. Resource Conservation	(1) 1		(1) 1
(1) Marine Mammal Protection Act	1		
Subtotal	(4) 4	(2) 2	(6) 6
TOTAL	(18)19	(10)10	(28)29
C. Social 9.0%			
1. Problem			
a. Communications		(1) 1	(1) 1
(1) Improving Information Flow Patterns		1	
b. Community Development	(4) 4	(6) 6	(10) 10
(1) Community Building Technology	1		
(2) Urban Public Safety	1		
(3) The Causes and Stimulation of the Willingness and Ability to Change		1	
(4) Social Innovation		1	
(5) Cultural Lag - the Resistance of Societies to Change		1	

TABLE 1 – List of Nominees and Candidates by Matrix Rows and Columns – Continued

Nominee	Nominee Count (Candidate Count) Questionnaire	Interview	Total
(6) Population Growth		1	
(7) Farm Mechanization - People Displacement		1	
(8) Using Technology to Solve Socio-Political Problems	1		
(9) Public Toleration Limits for Social Planning........		1	
(10) Root Causes of Alienation, Slums, Crime and Violence............		1	
c. Computers/Automation................	(2) 2	(3) 3	(5) 5
(1) Technical Information............		1	
(2) Software Lag (Lack of Programming Capability.......		1	
(3) Computer Organization Analysis...		1	
(4) Computer Applications to Overall Problem of Productivity...........	1		
(5) Computer-assisted Brain Extension ..	1		
d. Economics		(4) 5	(4) 5
(1) Decline of Defense Spending in Real Terms..........		1	
(2) Economy Shift from Product to Service .		1	
(3) The Impending Japanese World Economic Dominance		(1) 2	
(4) Government Subsidies of All Kinds.		1	
e. Education	(1) 1	(5) 6	(5) 7
(1) Assessment of Education..........	1	(1) 2	
(2) Practitioner Credentials: Competence vs. Degrees		1	
(3) The Military's Educational Role in the Society.........		1	
(4) Academic Ability to Respond to Change		1	

Nominee	Nominee Count (Candidate Count) Questionnaire	Interview	Total
(5) Transferring Intellectual and Managerial Constructs - Particularly to Presidential Advisors		1	
f. Energy	(1) 1		(1) 1
(1) Power Plant Location Methodology	1		
g. Management	(2) 2	(12) 13	(13) 15
(1) Private Minority Hiring Improvement..........	1	1	
(2) Employee Motivation	1		
(3) Responsibility of Organizations to Employees - Job Skills or Total Development......		1	
(4) Second Careers as an Increasing and Desirable Life Pattern		1	
(5) Business Shift from Competition Against Other Firms to Collusion Against Consumer		1	
(6) Need for Managerial Science Diffusion...........		1	
(7) Improving People Utilization		1	
(8) Attitude Shift on Work/Risk Taking/Welfare........		(1) 2	
(9) Manpower Utilization of Older Technicians		1	
(10) Personal Technological Obsolescence		1	
(11) Common Indexing System for Science and Technology.....		1	
(12) Relationship of Various Federal Functions......		1	
(13) Technical (Professional) Manpower Planning Structure and Process.....		1	

TABLE 1 — List of Nominees and Candidates by Matrix Rows and Columns — Continued

Nominee	Nominee Count (Candidate Count) Questionnaire	Interview	Total
h. Mental Health		(6) 6	(6) 6
(1) The Loser Syndrome - Re-inspiring the Dropout		1	
(2) Overcoming Risk Avoidance Personalities		1	
(3) The Social Impacts of Chauvinism, Xenophobia and Paranoia		1	
(4) The Causes and the Means of Countering Dysfunctional Myths		1	
(5) The Causes and Stimulation of Ambition and Upward Mobility		1	
(6) Chemical Impact on Human Behavior		1	
i. Policy	(3) 3	(5) 7	(8) 10
(1) U.S. World Leadership		1	
(2) Extrapolation Effects in Analysis		1	
(3) Legislative Impacts on Technology		1	
(4) Federalization of All Sciences	1		
(5) National Science Policy	1		
(6) Foreign Policy	1		
(7) Providing Visibility for Hidden Subsidies and Other Special Privilege by Law		1	
(8) Technology Transfer		(1) 3	
j. Politics		(6) 6	(6) 6
(1) The Trend Toward More Political Control of Business and Society		1	
(2) Redrawing Political Boundaries		1	
(3) The Effect of Election Cycles on Cultural Progress		1	
(4) Patterns of Demagoguery		1	
(5) Rule by the Technological Elite		1	

Nominee	Nominee Count (Candidate Count) Questionnaire	Interview	Total
(6) Increasing Federal Executive Power (OMB, Impounding Funds)		1	
k. Public Safety	(1) 1	(3) 3	(4) 4
(1) Crime		1	
(2) Application of Science to Forensics	1		
(3) Law Reform		1	
(4) Psychological Standards for Law Enforcement Officers		1	
l. Resource Conservation		(3) 3	(3) 3
(1) Natural Area Preservation		1	
(2) Historical Area Preservation		1	
(3) Recreation Area Preservation		1	
m. Resource Use	(2) 3	(2) 3	(3). 6
(1) Land Use, Selective and Multipurpose	(1) 2	(1) 2	
(2) Control of Surplus Agricultural Capacity	1		
(3) Shift of Allocation of Resources from Military		1	
n. Sociology		(1) 1	(1) 1
(1) Democratization of the Military Services		1	
Subtotal 9.0%	(16)17	(57)63	(73)80
2. Technology 7.4%			
a. Community Development		(2) 2	(2) 2
(1) Centralized (State & Federal) Planning for State Programs		1	
(2) Patterns of Cultural Breakthrough Potential (Japan & China vs. Latin America & India)		1	

TABLE 1 — List of Nominees and Candidates by Matrix Rows and Columns — Continued

Nominee	Nominee Count (Candidate Count): Questionnaire	Interview	Total
b. Computers/Automation	(4) 4	(1) 1	(5) 5
(1) Increased Demand for Information on Transfer of Bonds & Funds	1		
(2) User-oriented Programming Languages	1		
(3) Computer-driven Urban Information Systems	1		
(4) ADP in Criminal Justice	1		
(5) Voice-Computer Linkage		1	
c. Consumer Behavior	(1) 1		(1) 1
(1) Mass Tourism	1		
d. Economics	(1) 1	(3) 3	(4) 5
(1) Revenue Sharing	(1) 2		
(2) Reprivatization of Governmental Activities		1	
(3) Cost as an Engineering Consideration		1	
(4) Problem of Governvernment Procurement		1	
e. Education	(3) 3	(7) 7	(9) 10
(1) Educational Technology	1	1	
(2) Automated Instruction		1	
(3) Use of Domestic Satellites for Education	1		
(4) The "Less Than Baccalaureate Degree"	1		
(5) Lifelong Continuing Education		1	
(6) Academic Governance		1	
(7) Evaluating the Educational Product		1	
(8) Inducing Ambition and Effort to Improve		1	
(9) Impulse and Resistance to Technical and Cultural Change		1	
f. Health Care		(3) 3	(3) 3
(1) Technological Standardization for the Handicapped		1	
(2) Diversionary Programs for Drug Users & Alcoholics		1	
(3) Bio-feedback Implications		1	
g. Management	(2) 2	(8) 9	(9) 11
(1) The Temporary Organization		1	
(2) Optimal Organization Size		1	
(3) Techniques of Restructuring Organizations and Institutions		1	
(4) Vested Interest as a Deterrent to Good Management		1	
(5) Manpower Planning Requirements		1	
(6) The Rapid Advance of Managerial Technology		1	
(7) Flexible Work Schedules	1	(1) 2	
(8) Early Retirement	1		
(9) Technology for Decision-monitoring and Evaluation		1	
h. Mental Health		(1) 1	(1) 1
(1) Technology of Mental Health Services (General)		1	
i. Policy		(4) 4	(4) 4
(1) Government Manpower Policy and Planning		1	
(2) Exporting Zero Population Growth to Developing Cultures		1	
(3) Government Planning and Management of Industry		1	
(4) Return on Investment as Applied to Developing Nation's Resource Allocation		1	

TABLE 1 – List of Nominees and Candidates by Matrix Rows and Columns – Continued

Nominee	Nominee Count (Candidate Count)		
	Questionnaire	*Interview*	*Total*
j. Politics		(3) 3	(3) 3
(1) Present Legal Structure Response to New Ideas		1	
(2) Legislative Lobbying		1	
(3) Bigotry as a Political Tool		1	
k. Public Safety		(4) 4	(4) 4
(1) Penal Reform		1	
(2) Cable TV Utilization by Law Enforcement Community		1	
(3) Low-cost Burglar Alarm		1	
(4) Cashless Society to Fight Crime		1	
l. Resource Use	(1) 1		(1) 1
(1) State-wide Zoning and Control of Land Use	1		
m. Transportation	(1) 1		(1) 1
(1) Automated Freight Documentation System	1		
Subtotal	(12)14	(36)37	(48)51
3. Projects 6.4%			
a. Community Development		(2) 2	(2) 2
(1) Census Data for Local and Regional Community Planning		1	
(2) Attacking Utility (Sewage et al.) Cost to Building Permit Fee		1	
b. Computers/Automation	(2) 2	(1) 1	(3) 3
(1) Computerized/Cash-free Accounting Systems	1		
(2) Centralized Personal Data Banks	1		
(3) Direct Man-Computer Linkage		1	
c. Consumer Behavior	(1) 1		(1) 1
(1) Mobile Homes as a Life Style	1		
d. Economics	(1) 1	(4) 4	(4) 5
(1) Revenue Sharing	1	1	
(2) Mutual Funds		1	
(3) Universal Credit Card System		1	
(4) Work as Pay for Government Utilities		1	
e. Education	(2) 2	(1) 1	(3) 3
(1) Computer Aid to Instruction	1		
(2) Special Preparation of Teachers for Non-baccalaureate Post-high School Technician & Special Program gram	1		
(3) "Free" Schools		1	
f. Health Care	(1) 1	(5) 5	(6) 6
(1) Community Mental Health Center Program		1	
(2) Automated Physical Exams		1	
(3) Automated Sick Call Screening		1	
(4) Mission Oriented Hospitals		1	
(5) National Health Insurance	1		
(6) Escalating Health Care Costs		1	
g. Management		(6) 6	(6) 6
(1) Guaranteed Minimum Wage		1	
(2) Corporate Conglomerates		1	
(3) Multinational Corps		1	
(4) Value Engineering		1	
(5) "Incentivizing" Cost Reduction		1	
(6) Production Line Absenteeism		1	
h. Policy	(3) 4	(3) 3	(6) 7
(1) Environmental Controls (Legislative)	(1) 2		
(2) Environmental Impact Statements	1		
(3) Technology Assessment	1		

TABLE 1 – List of Nominees and Candidates by Matrix Rows and Columns – Continued

Nominee	Nominee Count (Candidate Count)		
	Questionnaire	*Interview*	*Total*
(4) Extra-political Regulatory Agencies		1	
(5) Flouridation Controversy as a Pattern of Technology Assessment		1	
(6) The Supersonic Boom Tests as a Social Pattern in Technology Assessment		1	
i. Politics.............		(3) 3	(3) 3
(1) Separation of Powers in the Federal Government		1	
(2) The Present and Future Illusory Democracy		1	
(3) Shifting OST Functions to NSF		1	
j. Public Safety........		(5) 5	(5) 5
(1) Capital Punishment - Pros and Cons ...		1	
(2) De-institutilization (Putting a Man in a a Community Installation Instead of a Jail		1	
(3) Update of President's Crime Commission of 1967...........		1	
(4) Life Tenure for Judges..........		1	
(5) Idemnify Schools for Damage with Parents Underwriting Costs.....		1	
k. Resource Use	(1) 1	(2) 2	(3) 3
(1) Decisofion-making Criteria in Land Use............	1		
(2) Welfare Recipients as a Work Force ..		1	
(3) Defense Budget Reduction		1	
l. Sociology...........		(5) 6	(5) 6
(1) The Public Morale of the Thirties as a Social Pattern		1	
(2) Forced Integration...........		1	
(3) Communes		1	
(4) Telecommunications Load on Social Workers ..		1	
(5) All Volunteer Service.........		(1) 2	
m. Transportation.....		(2) 2	(2) 2
(1) Impact of Tourism on Airport Services...		1	
(2) Nationalization of the Railroads...		1	
Subtotal	(12)12	(39)40	(51)52
TOTAL 22.8%	(40)43	(132)140	(172)183
GRAND TOTAL 100%	(156)188	(226)269	(382)457

N76-15944

III. INSTITUTIONALIZATION OF TECHNOLOGY ASSESSMENT

F. Southern Regional Workshop on Technology Assessment

Vary T. COATES and
John E. MOCK

October 1974, pp. 1-5; 11-12;
22-24

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FOREWORD

A three-day conference on technology assessment for State and local officials was held on the campus of the Georgia Institute of Technology, in Atlanta, May 6-8, 1974. Participants included scientists, engineers, planners, economists, and administrators from most of the Southern States and from many of that region's universities and research centers. The Conference was co-sponsored by the Governor's Science Advisory Council of Georgia and The George Washington University Program of Policy Studies in Science and Technology. The objective was to provide information about, and training in, technology assessment for those who must formulate policy and make critical decisions about technological programs and projects at the State and community levels, where the impacts of technological development are most directly felt. The Southern Regional Conference on Technology Assessment was supported by the National Science Foundation, Office of Intergovernmental Science and Research Utilization.

Technology assessment is applied, problem-oriented, multidisciplinary research which aims at anticipating and evaluating the consequences of a technological development in terms of its impact on the economy, the environment, the institutions, and the quality of life of a community or a society. Technology assessment is intended to inform and improve decisionmaking in the public and the private sectors, by broadening the considerations that go into that decisionmaking, giving it a longer-range perspective, and taking account of secondary, unintended consequences as well as immediate, direct costs and benefits.

Since Congressman Emilio Daddario first introduced the term "technology assessment" in proposing the establishment of a Congressional Office of Technology Assessment in 1966, the Federal Government has taken the lead in developing and using technology assessment. The National Science Foundation, over the last two or three years, has provided more than eight million dollars for comprehensive technology assessments in a wide range of technological and problem areas. An Office of Technology Assessment was established in 1972 (P.L. 92-484, October 13, 1972) to serve the U.S. Congress. But State and local governments also must grapple with the complex issues raised by science and technology as they impact on people's lives. Power plant siting, highway and airport construction, development of natural resources, cable T.V., and health care delivery systems—these and many other technological programs and projects require decision at the State and community level and raise complicated problems of equity and conflicting interests.

In 1971 a Working Conference on Technology Assessment was sponsored by the National Science Foundation and convened by the National Academy of Public Administration. From this Working Conference grew the State Technology Assessment Panel, which in 1972 produced a report which said:

> Technology assessment is a legitimate and necessary State function. To be most effective the technology assessment process must be applied where the principal authority to act is located.

The Panel therefore recommended that:

> The National Science Foundation should undertake a series of projects to develop better information about how successful technology assessment has been accomplished in States and to stimulate interest among key State officials in technology assessment.

The Southern Regional Conference on Technology Assessment is one product of the National Science Foundation's effort to carry forward that recommendation. As Co-Chairmen of the Conference, we wish to express our appreciation for the full cooperation and great effort of the sponsoring organizations; of Mr. Edward T. Kelly, the National Science Foundation Program Manager; of the host institution; and of the many Speakers and participants in the Conference. We hope that this may be the first of a number of similar conferences in other regions of the United States; we also hope that this Conference has been of value to the dedicated State and local decisionmakers and administrators who daily struggle with the complex problems of our highly technological society.

—Dr. Vary T. Coates and
Dr. John E. Mock, Co-Chairmen

October 15, 1974

THE PROGRAM

FIRST SESSION. WHAT IS TECHNOLOGY ASSESSMENT? Dr. John E. Mock, Chairman

KEYNOTE ADDRESS
Mr. Daniel V. De Simone, Deputy Director, Office of Technology Assessment, U.S. Congress

SURVEY OF RECENT FEDERAL ACTIVITY IN TECHNOLOGY ASSESSMENT.
Dr. Vary T. Coates, Associate Director, Program of Policy Studies in Science and Technology, The George Washington University

LUNCHEON SPEAKER: The Honorable Dean Rusk, Professor of Law, University of Georgia

SECOND SESSION. TECHNOLOGY ASSESSMENT AT STATE AND LOCAL LEVELS. Dr. Vary T. Coates, Chairman

OVERVIEW OF STATE AND LOCAL TECHNOLOGY ASSESSMENT.
Mr. Edward T. Kelly, Program Manager, Office of Intergovernmental Science and Research Utilization, National Science Foundation

TECHNOLOGY ASSESSMENTS DESIRED BY THE STATES
Dr. John E. Mock, Science Advisor to the Governor of Georgia

THIRD SESSION. TECHNOLOGY ASSESSMENT: ORGANIZATION, MANAGEMENT, METHODOLOGY. Dr. John E. Mock, Chairman

HOW TO DO TECHNOLOGY ASSESSMENT.
Mr. Joseph F. Coates, Program Manager, Office of Exploratory Research and Problem Assessment, National Science Foundation

HOW TO ORGANIZE A COMPREHENSIVE TECHNOLOGY ASSESSMENT.
Dr. Steven Ebbin, Program of Policy Studies in Science and Technology, The George Washington University

COUNTER-INTUITIVE THINKING AND ITS PLACE IN TECHNOLOGY ASSESSMENT.
Dr. Marvin Cetron, President, Forecasting International, Ltd.

HOW TO DO TECHNOLOGY ASSESSMENTS FOR LESS THAN $5000.
Dr. Andre Delbecq, Chairman, Department of Management, University of Wisconsin, Madison

HOW TO WRITE AN ENVIRONMENTAL IMPACT STATEMENT.
Professor Gene Willeke, Environmental Research Center, Georgia Institute of Technology

LUNCHEON SPEAKER: Professor Melvin Kranzberg, Georgia Institute of Technology

FOURTH SESSION: WORKSHOPS.
Demonstration workshops conducted by Mr. Coates, Dr. Ebbin, and Dr. Delbecq

FIFTH SESSION: THREE TECHNOLOGY ASSESSMENTS. Dr. Vary T. Coates, Chairman

PLOWSHARE TECHNOLOGY ASSESSMENT.
Mr. Wyatt Rogers, Associate Director, Western Interstate Nuclear Board

TECHNOLOGY ASSESSMENT OF SOLID WASTE MANAGEMENT IN CONNECTICUT.
Dr. Jules Mirabal, General Electric Research and Development Center

TECHNOLOGY ASSESSMENT: INTEGRATION OF HOG FARMING.
Dr. Ivan Smith, Midwest Research Institute

AN EVALUATION OF TECHNOLOGY ASSESSMENT.
Mr. Walter A. Hahn, Senior Specialist in Science and Technology, Science Policy Research Division, Congressional Research Service, Library of Congress

NOTE: Due to travel schedules, the speakers did not appear in exactly the order listed.

TECHNOLOGY ASSESSMENT AT THE STATE AND LOCAL LEVEL: HIGHLIGHTS OF THE CONFERENCE

The Southern Regional Conference on Technology Assessment pulled together and gave visibility to experience which States and communities have recently gained in Technology Assessment. Each assessment is unique, yet the problems encountered, the alternative solutions tried, and the lessons learned can often be helpful to others who must struggle with the complex issues of a highly technologized society. It will therefore be useful to highlight themes which emerged in the discussions and salient insights offered by speakers at the Conference.

1. The Need

There can be little doubt that Technology Assessment—or as many prefer to say, social impact analysis—is not only appropriate but necessary in planning and decisionmaking at all levels of government. This is now widely recognized by State and local officials. How to institute improvements in established procedures, and where to find the resources and capability to do Technology Assessment, are more difficult questions.

It is in communities and small regions—where people live and work—that the real impacts of technological development are felt. However "quality of life" may be defined (and definitions are legion), it is surely manifested in the everyday conditions under which individuals and families live, work, and spend their leisure. Housing, transportation, energy, utilities, social and health services, education, public services—these are the problems with which State and local governments continually grapple, under intense pressures of scarce dollars, unavailable information, conflicting political demands, and uncertain outcomes. Federal programs can help, but may disappear at the end of a fiscal year. Federal policies may change not only with a change of Administrations, but overnight. Research and information coming from the National level may not be applicable to local situations. But State and local problems continue, and decisions made today may lock a community into a unforeseen chain of consequences or limit options for years to come.

Areas smaller than the nation are moreover particularly vulnerable to converging trends: for example, underdevelopment and unemployment, rising demands for resource extraction, and increasing pressure for environmental protection. Many decisions involve irreversible and large scale changes in the physical environment and in land use, or commitment of funds and nonrenewable resources over long periods of time. Caught in a vise of conflicting and converging needs, responsible officials must of necessity make decisions, usually without sufficient information to identify all possible alternatives and fully evaluate necessary trade-offs.

Public policy related to technology, often thought of as a "national" concern, is therefore directly and intimately a part of local and State decisionmaking, and all techniques which hold promise for improving and broadening the process of formulating and implementing wise public policy are increasingly of interest in all levels of government. Technology Assessment, which aims to provide decisionmakers with better information about the possible consequences of their actions and to help them better manage uncertainty, is such a technique.

2. The Experience

Two States have already established an institutional base for Technology Assessment: The Georgia Center for Technology Forecasting and Technology Assessment in 1970 and the Hawaii State Center for Science Policy and Technology Assessment in 1971. Other States are investigating or experimenting with assessment through their Governor's science advisors, through legislative councils, or through other mechanisms. Re-

gional cooperation is another device used, for example in the assessment of Operation Plowshare, reported at the Conference. Most States, however, although paying increased attention to environmental concerns and gradually broadening the scope of planning, have not attempted comprehensive Technology Assessments. As one speaker at the Southern Regional Conference summed up the situation, assessment at the State level has been "problem-oriented rather than technology-focused, reactive rather than anticipatory, and limited to the three E's—energy, economics, and environment." Newly emerging technologies and social technologies, with few exceptions, have been neglected.

Such assessments as have been made have generally been intended to serve the needs of the Executive branch of State governments. Little or no Technology Assessment—in the States or in the Federal Government—has been done for or by regulatory agencies, although regulation and rate-setting are among the most effective methods of directing and controlling technological development. State legislatures, usually poorly supplied with informational and staff services, have not yet followed the lead of the U.S. Congress in establishing an Office of Technology Assessment, although policy making is pre-eminently a legislative function.

3. The Obstacles

Money, time, and trained people are in short supply in State and local governments. Staff people with experience and capability in interdisciplinary, policy-oriented, applied research are particularly scarce. Agency administrators (and State legislators) tend to be suspicious and intolerant of proposals for "more study" rather than immediate action.

Political pressures and interest group demands are immediate and intense. In each of the three Assessments presented at the Conference the study teams had encountered problems related to political sensitivities—interjurisdictional rivalries, the suspicion and fear of a "threatened" industry, the affiliation of legislators with interest groups affected by the technology.

Technology Assessments, by their nature, usually deal with controversial subjects. A Conference participant noted that while assessors at the Federal level may argue about the value of public participation or how to achieve it, "the closer you get to the grass roots, the more public participation you will get"—whether or not you invite it. Potential detrimental impacts may appear more dramatic and galvanize opinion more effectively than social benefits (which may be more important but more generalized). Because of this intense public interest, there is more danger of Technology Assessment becoming "technology arrestment" at the local than the national or societal level.

State agencies are of course subject to the same barriers that Federal agencies find in attempting to broaden planning and evaluation procedures. Bureaucratic inertia, institutional and personal biases, special constituencies, and the necessity for self-preservation do not contribute to an ability to ask hard questions about downstream consequences. Fragmented responsibilities and narrow organizational charters are not conducive to comprehensive analysis of social impacts. For State as well as Federal decisionmakers, the pressures push toward short-term optimization rather than anticipatory, even-handed judgment.

4. The Strengths

As compared to national or societal assessments, subfederal Technology Assessment can deal with smaller geographical areas, less heterogeneous populations, and more easily identifiable parties at interest. Data is likely to be less aggregated. Direct access can be had to potentially affected segments of the population. A "home-grown" Assessment team, attuned to the mores and idiom of the locality, has a subtle advantage

which can best be appreciated by researchers who have had the experience of being regarded suspiciously as "outsiders."

Some areas of technology are at present extremely resistant to assessment because so little data is available. This is particularly true of very innovative physical and social technologies—for example, the guaranteed annual income, or at one time, the contraceptive pill. It may not be possible to predict public acceptability of the technology, or the ways in which people will use, misuse, and abuse it. In such cases, "social experimentation," or a monitored trial in a limited area, can provide a firmer base for Technology Assessment. Local communities provide the ideal site for many such social experiments.

In some cases such social experiments will occur naturally—for example, when one or two communities in a state adopt cable television, a Technology Assessment by the State of the impacts in these communities can assist other local governments to make wise decisions about cable television franchising.

5. Priorities

In a survey conducted for the National Science Foundation, State officials indicated the following as priority areas for Technology Assessment:

—Natural resources and environmental management: coastal zone and wetlands management, solid waste management systems;

—Energy systems: power plants, off-shore oil wells or supertanker facilities, solar and geothermal energy;

—Human resource programs: manpower training and educational equalization programs, educational technology, health care delivery systems;

—Transportation: special bus lanes, parking restrictions, mass transit systems, airports, highways;

—Government functions: integrated information systems, "little city halls," mobile police units;

—Economic development: industrial parks, shopping centers, new factories;

—Communication systems: cable television franchises;

—Community development: golf courses, other recreation facilities, high rise or scattered site public housing, annexation.

Although local governments have been engaged in such services and functions for a very long time, there is still no reliable way of anticipating how much benefit will result for the community from a new project, or of judging the comparative benefits of competing demands for scarce resources.

6. Ways and Means

Comprehensive Technology Assessments are expensive: experience gleaned at the Federal level indicates a minimum of $100,000 to $200,000 for broad-scale assessments. State and local governments, especially the poorer or less populous, do not have such resources to command for applied research. But comprehensive Technology Assessments have been done at the regional level, through:

—industry and government cooperation;

—pooling of regional resources;

—Federal funding.

A study of solid waste management systems for the State of Connecticut (reported at the Conference) was done by a corporation which also made a substantial contribution to meeting the cost of the study. The assessment of Operation Plowshare, also reported at the Conference, was a cooperative effort of four states. The Port of New York Authority, established by interstate compact, funded a comprehensive assessment of proposed extension of Kennedy Airport runways into Jamaica Bay. A Technology Assessment of the integration of pig farming, of interest to several regions of the country, is being sponsored by the National Science Foundation, and it is worth noting that several State universities are now performing Technology Assessments of interest to their areas with NSF funding.

Georgia and Hawaii have had much success in carrying out Technology Assessments using blue-ribbon panels made up of leaders of industry, academic experts, government officials, and civic leaders. These assessments are usually exploratory rather than comprehensive, but tend to carry substantial impact with State Governors and legislators.

"Mini-assessments" (that is, short exercises designed to draw out information and expert opinion, identify areas of consensus (and disagreement), and develop recommendations for policymakers) can be used where there are not funds or time for comprehensive Technology Assessment. The Hawaii State Center for Science Policy and Technology Assessment has successfully adapted the Nominal Group Technique (demonstrated at the Conference by Professor Andre Delbecq) for use in two- or three-day sessions to assess the potential impacts and policy considerations related to mariculture and other technologies. Other techniques for structuring small group interactions can also be used for this purpose.

Every State has un-utilized resources for Technology Assessment. State universities may contain a nucleus of people familiar with Technology Assessment, experienced in interdisciplinary research, and having a commitment toward public service (and in some cases, with available research funds). Depending on the university, interdisciplinary science policy programs, Departments of R&D Management, or broadly-based Engineering Schools are possible routes of ingress to such people. Corporate management, State academies of science, and professional societies are other sources of expertise. The Intergovernmental Personnel Act of 1970 can sometimes be utilized to borrow talent from the National Government agencies. State and local agencies themselves can be tapped for people who are dissatisfied with conventional modes of evaluation and not afraid to ask hard questions.

Public interest and environment groups often include members with training and experience in physical and social sciences who are under-utilized because they are presently homemakers or retired. Many citizen groups are experienced in organizing people with diverse backgrounds into study groups to gather information and explore issues. They are also able to disseminate and build community support for implementing the results of the Assessment. Organizing Assessment efforts, managing interdisciplinary groups, and reducing representational bias, on the other hand, call for a trained and experienced Project Leader.

7. Implementation

Experienced Technology Assessors at the Conference warned that the quality of an assessment is no guarantee that its conclusions or recommendations will be implemented. Many factors and considerations, other than reliable information about long-range consequences, are necessarily involved in making a decision. Even if a Technology Assessment directly leads or contributes to a wise decision, it will seldom be given the credit, since the political leaders will instead point to their own discernment and wisdom.

It is seldom, however, that a Technology Assessment will produce definitive and clear-cut recommendations. More often, if successfully done an assessment will lay out a range of alternative policy strategies, each involving uncomfortable trade-offs which must be made. Technology Assessment is an input to and an

aid to good decisionmaking; it does not seek to usurp the prerogatives of the responsible decisionmaker. The ultimate rationale for Technology Assessment is that, at any level of government, a decision made on the basis of all available information and clearly recognizing the inevitable uncertainties is likely to be better than a decision made in avoidable ignorance.

—Vary T. Coates

SUMMARY OF THE SESSIONS

WHAT IS TECHNOLOGY ASSESSMENT?

Dr. John E. (Ted) Mock, Co-Chairman of the Conference, is the Science Advisor to the Governor of Georgia

Technology assessment, said Ted Mock in opening the Conference, "may be the answer to Murphy's Law." (Murphy's Law, in its classical formulation, states that "whatever can go wrong, will go wrong.") Technology assessment, he explained, is "the systematic study of the effects on society that may occur when a technology is introduced, extended, or modified, with special emphasis on impacts which were unintended or delayed."

During the 1960's, he reminded the audience, many Americans became concerned with the impact of technology on their environment, on their safety, and on the quality of their life style. Long accustomed to think of science and technology as harbingers of progress and a better way of life, Americans—faced with smog, polluted rivers, congested cities, and disastrous side-effects of drugs such as thalidomide—woke up to the idea that the most promising of technologies may also have unanticipated, unwanted consequences. In their alarm and dismay, Mock pointed out, some have veered toward anti-scientism and even anti-intellectualism.

Emilio Daddario was then Chairman of the Subcommittee on Science, Research and Development of the Committee on Science and Astronautics, U.S. House of Representatives

Public Law 92-484 (Oct. 13, 1972). A complete legislative history, and a listing of members of the Technology Assessment Board and Advisory Council, may be found in ANNUAL REPORT TO THE CONGRESS by the Office of Technology Assessment, March 15, 1974

It was in this context that Congressman Emilio Daddario in 1966 first proposed to the U.S. Congress that it establish an Office of Technology Assessment.

Mr. Daddario and his Subcommittee began systematically to explore the feasibility of a better system for anticipating the effects of technological development and for supplying Congress, other decisionmakers, and the American public with the information needed to formulate wise policy. Six years later, the Office of Technology Assessment was established, and former Congressman Daddario, who earlier had resigned from Congress, was appointed as its first Director.

The Deputy Director of OTA, Mr. Daniel V. De Simone, was present to give the keynote address for the Southern Regional Conference.

THE CONGRESSIONAL OFFICE OF TECHNOLOGY ASSESSMENT

KEYNOTE ADDRESS

Mr. Daniel V. De Simone, Deputy Director, OTA

"It is impossible to go back," said Dan De Simone. The sense of progress and optimism once natural to an increasingly affluent society gave way in the 1960's to a questioning of the inevitability of progress. That unguarded optimism, he said, cannot be restored, but neither can the development of technology be reversed, nor would we wish it to be. Instead, society must learn to handle technology more wisely, "but we must assess its real benefits and costs before we can handle it wisely."

TECHNOLOGY ASSESSMENT AT STATE AND LOCAL LEVELS

OVERVIEW OF STATE AND LOCAL TECHNOLOGY ASSESSMENT

Edward T. Kelly, Program Manager, Office of Intergovernmental Science and Research Utilization, National Science Foundation

Ed Kelly began the second session of the Conference by observing: "Technology Assessment is too important to be left to the Federal Government." The State and local levels are where Federal technology is implemented, the impacts felt, and services delivered. Moreover, State and local governments themselves initiate and implement technological decisions and programs. But at this level the description of T.A. is vague and its organization undefined. T.A., Kelly said, may be defined operationally, at the State levels as "whatever the states say T.A. is," just as planners often have defined urban development as "whatever we are doing now."

Kelly characterized present State and local technology assessments as follows: they tend to be problem-driven rather than technology-driven, reactive rather than anticipatory, and focused largely on the three E's—environment, energy, and economics. Social technology, though of great importance, is all too likely to be ignored currently as as a subject for assessment. The States have one great advantage, that of flexibility; if a technology (or a technology assessment) does not work in one State, it still can be tried in others—States and local communities offer laboratories for societal experiments. Technology assessments at the subnational levels of government can deal with technologies and problems common to many States or specific to their own area. But they must, Kelly warned, be particularly sensitive to the "convergence of events," the coming together of divergent trends, changes, and pressures to pose unexpected problems—and opportunities.

Public participation is a "given" in State and local assessments, Kelly noted: "the closer to the grass roots you are, the more public participation you will get—whether it is wanted or not." By the same token, there is more danger of "technology arrestment" as a result of assessment, because the pressures are more immediate and more effective at the grass roots level.

Technology assessment is needed for both the legislature and the executive in State governments. (And, Kelly said, it is particularly lacking in State regulatory agencies, as it is at the Federal level.) The policy formulation process is basically a legislative function, he reminded his listeners, but State legislatures have very little informational and analytical support and assistance. In general, the lack of in-depth capability for evaluative research in the State governments led Kelly to call for strong links between universities and their State governments. The universities can provide the resources and the opportunity that will allow the States to carry their rightful share of technology assessment.

TECHNOLOGY ASSESSMENTS DESIRED BY THE STATES

Dr. John E. Mock, Science Advisor to the Governor of Georgia

"From urban blight to rural flight," said Ted Mock, "it is the States which must face the most difficult problems requiring technology assessment, yet they lack the tradition of doing such anticipatory evaluation." They also lack the expertise, the money, and the institutional framework for T.A. Yet some States, notably Hawaii, New York, California, and Georgia, have established an institutional base for T.A. and are rapidly acquiring the experience, the capability, and the tradition. The State of Georgia, for example, under the aegis of the Governor's Science Advisory Council, has done assessments of health delivery, cable T.V., natural gas supply, geothermal energy potential, an information service center, development of new cities, remote sensing (ERTS), metrication, and the impact of the energy crisis. These studies were useful and influential, Mock asserted, and they could be done at fairly low cost to the State because of services donated and capability supplied by industry, local communities, and State agencies.

CANDIDATES AND PRIORITIES FOR TECHNOLOGY ASSESSMENT: A SURVEY OF STATE OFFICIALS, by John E. Mock for the Office of Exploratory Research and Problem Assessment, Research Applications Directorate, National Science Foundation, August 1973. This is Volume III of a series entitled CANDIDATES AND PRIORITIES FOR TECHNOLOGY ASSESSMENTS. The other volumes are: Volume I, SUMMARY OF FOUR STUDIES OF CANDIDATES AND PRIORITIES FOR TECHNOLOGY ASSESSMENTS; Volume II, A SURVEY OF FEDERAL EXECUTIVE AGENCY PROFESSIONALS; Volume IV, AN APPROACH TO PRIORITIES; and Volume V, A SURVEY OF CANDIDATE TECHNOLOGIES

Early in 1973 Mock carried out a survey of State officials to identify candidates and priorities for technology assessment. The survey, commissioned by the National Science Foundation, was addressed to Governors' Science Advisors, Directors of State planning agencies, Directors of State departments of natural resources, and Directors of economic development. The respondents (34% of the 200 officials) identified approximately 250 different candidates for T.A. Areas of major concern were natural resources and environmental management (land use, power plant siting, coastal zone management, desalinization, pollution control); energy (coal gasification, geothermal energy, strip mining, nuclear power plants); and human resources (health care delivery systems, educational technology). A number of officials identified as especially important those areas where there is pressure from converging trends; energy shortages and environmental enhancement, increased automation in industry and lengthened life spans. As predicted earlier by Ed Kelly, Mock noted that State officials framed their candidates in terms of problems rather than in terms of a specific technology.

Mock advised the participants that not all of their assessments will show immediate results—if measured by direct implementation of findings or recommendations. Decisionmaking is still the province of the Governor and the Legislature—it is a political process and reflects other considerations and imperatives besides those informational inputs from the assessment. And, he also noted, even when assessments have a direct and positive influence on the decision, it is likely that the influence will not be acknowledged or spotlighted, since political leaders will themselves take the credit for the wisdom of their decisions. Nevertheless, the T.A. will provide a more rational and farsighted base for decisions than States and communities in the past have had available.

pro forma fashion; and, above all, Willeke concluded, one must be prepared to revise and modify, as only through a reiterative process can an environmental impact statement, or a technology assessment, be performed adequately.

THREE TECHNOLOGY ASSESSMENTS

Three recent ongoing technology assessments of interest to State officials were described at the Conference: an assessment of Operation Plowshare (the use of nuclear explosives to produce oil and gas in Western States), an assessment of solid waste management technology for the State of Connecticut, and a technology assessment of integration of hog farming, sponsored by the National Science Foundation. Although only one of these appeared to the Conference participants to fit the definition of comprehensive technology assessment, all of the presentations provided valuable insights into the organization and management of complex, multidisciplinary, policy-oriented applied research—a problem with which all State officials find themselves increasingly forced to grapple.

OPERATION PLOWSHARE

Mr. Wyatt Rogers, Associate Director, Western Interstate Nuclear Board

The assessment of Operation Plowshare, for example, as reported by Wyatt Rogers, demonstrated that it is feasible for States to cooperate in assessing developments of mutual concern and that through this technique States can have an impact on Federal programs. The assessment, funded jointly by the National Science Foundation and a compact of twelve States, grew out of a serious concern by western States about a proposed, large-scale commercial program which would utilize nuclear explosives for oil and gas stimulation. The proposed development was viewed by many as an unacceptable assault on the environment, safety, and resources of one region in order to produce presumed benefits for the nation as a whole. The Western Interstate Nuclear Board and researchers from five Universities in the Rocky Mountain region conducted fourteen separate studies over a fourteen-month period (with an additional six months of integrating and "recycling" the results of these studies). Major emphasis was on four areas of concern: impacts on the environment, impacts on utilization of the region's other natural resources, jurisdictional and legal implications for State and commercial Plowshare technology, and methods of encouraging public participation in related decisionmaking. The final results of the study were published by WINB in early 1974. Following the study, representatives of the affected States met to discuss possible joint policy actions to regulate Plowshare projects.

PLOWSHARE TECHNOLOGY ASSESSMENT: IMPLICATIONS TO STATE GOVERNMENTS. Glenn A. Whan, Project Director

A TECHNOLOGY ASSESSMENT OF SOLID WASTE MANAGEMENT

Dr. Jules Mirabal, General Electric Research and Development Center

The technology assessment of solid waste management technology, reported by Jules Mirabal, was thought by most Conference participants to represent more nearly a technical feasibility study than a technology assessment. But as a highly sophisticated example of multidisciplinary applied research in a complex and politically sensitive area, it was nonetheless of great interest to the audience, particularly since it demonstrated a successful cooperation between industry and State government. (The industry—General Electric Research and Development Center—specifically removed itself from subsequent competition to develop the solid waste management centers which were recommended by the study.) The assessment grew out of legisla-

tion calling for a State-wide masterplan to solve solid waste problems in 169 cities and towns in Connecticut. The master plan was required by the legislation to identify and implement solid waste technology which was "environmentally sound, economically feasible, and socially acceptable." On the basis of competition, G.E. was awarded a one-year contract for $450,000, with G.E. contributions bringing the total cost of the study up to $1.15 million. The study was organized around five major tasks: market analysis, transportation aspects, public information, business impacts, and capital acquisition. Mirabal mentioned in passing that because of "political realities" in the State of Connecticut, the area of solid waste collection was omitted from the study; the audience was quick to note the inference and comment on the political pitfalls that await technology assessors in dealing with public service functions in the State and local arena.

TECHNOLOGY ASSESSMENT OF INTEGRATION OF HOG FARMING

Dr. Ivan Smith, Midwest Research Institute

Ivan Smith reported on a comprehensive technology assessment of the integration of hog farming underway at the Midwest Research Institute and funded by the National Science Foundation. The assessment team was instructed to look at the broad societal and regional implications of the possible movement to vertical integration of the pork industry (from production of piglets through feeding to butchering) following the model offered by the beef and chicken industries. The study is to include impacts on the family farmer, the consumer (e.g., food prices and quality of product), labor and management needs, financial institutions, energy utilization, world food needs, and a variety of other affected parties and institutions. Ultimately, and unexpectedly, Smith said, the team find themselves forced to address such broad moral issues as whether the U.S. is justified in making red meat the staple of our diet, given the fact that it takes ten pounds of grain to produce one pound of beef.

The scope of the assessment, Smith pointed out, is reflected in the composition of the research team, with its consultants, which include agricultural experts, management experts, swine nutritionists and veterinarians, engineers, geologists, economists, political scientists, technology forecasters, transportation specialists, regional developers, land use lawyers, social psychologists, and marketing experts. An Oversight Committee further adds to the viewpoints and disciplines represented.

Describing the ongoing T.A. in detail, Smith drew some lessons which the team is learning and some goals which they are pursuing, which he feels should be a part of every assessment. A basic need, he said, is to analyze the driving forces which are bringing about a new technology (or a significant change in the way we perceive or use a technology). This includes a thorough understanding of the boundaries and the current state-of-the-art of the technology under study. Secondly, Smith went on, methodologies must be found and improved which are fitted to the special problems being investigated. Here Smith advised the group, "Watch out for the development of still more jargon—it is important to use the user's language," that is, to be

able to communicate directly with those who will need the information which the assessment will produce. Finally, the assessment report, Smith believes, should be organized by impact areas, and elements of the report directed at and written especially for the various segments of the population who will need to use it. He described for the group how the outline of the hog farming T.A. was developed early in the study to be used as a framework for the analysis as it developed. Separate sections of the report, aimed at categories of users, will be separable from the entire report for fuller and more targeted distribution.

COMMON THEMES

Several insights emerged from the presentations of ongoing assessments and the vigorous discussions which followed. In each of these studies, non-scientific political and bureaucratic individuals and scientists had managed to cooperate productively in spite of pronounced difficulties in communication and differences of viewpoint, values, and objectives. In each of the studies there were, or there may be in the future, political sensitivities and cross-currents which may limit or pose serious problems for the assessment as well as for its implementation: jurisdictional ambiguities in Operation Plowshare, control of solid waste collection by a powerful organization with alleged underworld ties, conflicts of interest between small farmers and agribusiness in the hog farming area. There is also the problem of scarce resources and limited capability when States must grapple with big science and high technology and the complex issues they pose—a theme constantly replayed during the Conference. This problem is most acute for the smaller or poorer States. Three possible means of dealing with the problem were illustrated by the three studies presented: regional pooling of resources by a number of States, cooperation between State governments and industry, and the seeking of funding from a Federal agency, in this case the National Science Foundation through its Research Applied to National Needs Program.

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III. INSTITUTIONALIZATION OF TECHNOLOGY ASSESSMENT

G. Emerging Trends in Technology Assessment

Vary T. COATES

April 1974, pp. 1-18

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EMERGING TRENDS IN TECHNOLOGY ASSESSMENT

Vary T. Coates, Ph.D.
Associate Director and
Head, Technology Assessment Group
Program of Policy Studies in Science and Technology

April 1974

This paper reviews recent and emerging trends and problems in Technology Assessment. In 1971 I conducted an extensive survey of T.A. activities.[1] Today I will update that study by describing what has been occurring in the last two or three years, as I have been able to observe it, and highlight some of the problems and issues which I see determining the future of Technology Assessment.

The bill establishing the Congressional Office of Technology Assessment was passed in October 1972. I begin with that Office, because I believe that what happens in and to that Office will be the critical factor in the future of T.A. The Technology Assessment Board, which is the policy-making organ, was appointed in February 1973. As most of you know, the Board consists of six Senators, three from each party, and six Representatives, again three from each party, and the Director, who is a non-voting member. (This is, I believe, the first time in more than thirty years that what is essentially a Congressional Committee has been established on the basis of party parity.) Senator Edward Kennedy is the first chairman, and will hold office throughout the 93rd Congress. The law provides that the next chairman shall be a Member of the House.

The Technology Assessment Advisory Council has also been appointed and consists of ten public members, whose names and affiliations appear on the attached list, along with the comptroller-General and the Director of the Library of Congress.

Mr. Emilio Daddario, who introduced the first bill to establish the Office in 1966 while a Representative from Connecticut, and thereby initiated the technology assessment movement, was appointed as the Director of the Office. The Associate Director is Daniel De Simone. Mr. De Simone had not been closely associated with technology assessment hitherto by those who had closely followed the developing movement. However, he had been the director of the large study, "A Metric America," while at the National Bureau of Standards, and had since moved to the National Science Foundation's Science and Technology Policy Office.

The Metric America study was in fact an assessment of social impacts of conversion to the metric system, relying in large part on public hearings and representation of interests--although the study was not called a technology assessment. Dan De Simone appears to have done his homework well and to have a good working understanding of technology assessment and what possibilities and pitfalls await the new Office.

Those pitfalls are, I believe, real and threatening. When the new OTA was first conceived by Mr. Daddario, he envisioned something like a much smaller GAO or Library of Congress; that is, an entity which would serve the Congress by supplying it with hard, reliable information, but which would be more or less independent of the internal politics of Congress. The new Office, unfortunately, much more closely resembles a joint committee, and thus faces the difficulties of accomplishing its work without appearing to violate the territory and jurisdictions staked out by other committees, of which it must at the same time attempt to serve the needs. A further difficulty and danger is that the present chairman of the T.A. Board is widely

viewed as a potential presidential aspirant. Without alleging in any way that Mr. Kennedy would attempt to, or would wish to, or would deliberately lend himself to, exploitation of the issues with which the Office must struggle in order to further his own political image, I fear that this potentiality will be another complication as the Office attempts to establish its initial role and record. The organization of the Office will lend itself to this suspicion. The T.A. Board has interpreted the establishing law in such a way that the Board has a small staff of its own, that is, a staff which serves the Board rather than the Director; Senator Kennedy's Science Advisor is the Executive Secretary of that staff.

As with any Congressional Committee, OTA will be subjected to pressure as it begins staffing. Mr. Daddario's strategy has been to delay appointment of program managers until after initial program areas and major topics were selected. Whether he will be able to select people with both knowledge of the technological subject areas and in-depth familiarity with technology assessment concepts and methodology, or whether his choices will be constrained by political considerations, we can only wait to see. Those observers who had for months been predicting the first few appointments have so far been surprised every time. Public hearings were scheduled to have been held in January or February to hear testimony from the heads of Executive agencies about their technology assessment programs and plans, but those Hearings did not occur, for reasons which are not clear; they may be held later this spring.

When the bill was passed last fall it was not highly controversial, but neither did it evoke great interest in Congress. The bill provides that

the assessment activities of the OTA may be initiated "upon the request of" the chairman of any Congressional committee, acting for himself, for the ranking minority member, or for a majority of the members of the committee; or may be initiated by the T.A. Board or by the Director in consultation with the Board. The fact is that most committee chairmen have little or no understanding of what technology assessment is, or what the Office could do. Their temptation will be either to try to use the OTA as a quick response information service to augment their own staff, or to play secrecy games and resent any "intrusion" of OTA into their territory. Mr. Daddario has been diligently calling on committee chairmen to educate them and to solicit their views in an attempt to ward off these dangers.

The "Energy Crisis" has generated in some quarters new cynicism about the ability of the government to manage complex technological issues or to prepare for problems which it has been possible to foresee for some time. At the same time, again in some quarters, the energy crisis has fueled a reaction against the environmental movement, or pushed environmental concerns into lower priority. This kind of facile cynicism, however, appears to be less important and will probably be less long-lasting than a much more important effect, a widespread realization that those who raise hard questions about national priorities, conservation of resources, and the necessity of exerting some public control and direction over economic and technological development can no longer be safely ignored or brushed away. This change in attitude may in the long-run cause the OTA to be treated with more seriousness than would otherwise have been the case, and if OTA can, in its first year or two, produce studies of demonstrable excellence,

insight, and value it will establish a credibility and influence that can make it a major innovation in the American governmental system. Certainly, although the Office itself lacks the usual levers of power hitherto considered absolutely necessary in Congress, it has leadership of great integrity, knowledge, and influence in its Board and in the Directorships and it is, above all, in the right place, at the right time in history.

The first task the Office has accomplished is to select six areas of emphasis for their first year ($2 million is to be committed before July 1, 1974). Obviously the OTA had some obvious criteria--they presumably wanted to fund technology assessments in areas which were important in terms of potential impacts, areas in which Congress must in the near future make decisions (but areas in which the major decisions for the next five to ten years have not already been made, or will not have been made before an assessment could be completed). One would also suppose that OTA would wish to choose areas in which its assessments might have a strong influence and the Office thereby establish prestige and credibility. OTA did make use of four NSF-funded studies of T.A. priorities.

The six areas chosen for technology assessments are: technologies related to food, energy, materials resources, oceans, bioequivalence of drugs, and international trade. Now Mr. Daddario, Mr. De Simone, and their (so far very small) staff will begin the task of problem and program definition within those six general subject areas.

There are a number of ways OTA may go, and a number of obvious mistakes they may make. If they tie themselves too closely to the immediate needs of the other Congressional committees, they may ask for assessments only of technologies which are already widely used but controversial--

such as off-shore oil drilling, pesticides, or strip-mining. It is true that in many such subjects comprehensive assessments are lacking and urgently needed. But too much emphasis on relevance to already obvious decision-making needs may lead them to ignore the decision needs which will arise in the future--that is, to overlook the more speculative and uncertain technological options and possibilities which will then catch us unprepared at some future time. OTA will then be trapped in the behavior Congress has always exhibited--reacting to today's crisis, solving yesterday's problems, and backing rumpfirst into the future.

OTA also runs the risk of concentrating too much on areas which, however important, are chosen because they are now a matter of public concern and thus already are generating action programs. It is unfortunate when action programs are initiated, and continue, without both a prior and an on-going assessment of their impacts. Nevertheless, to have a strong effect on decision-making, it is too late to begin a comprehensive assessment after a "crisis" is evident and action programs become the order of the day. By then directions have already been chosen--or dictated, political and economic capital has been committed, bureaucracies have been generated, and interests have been mobilized. If only very limited resources can be allocated to assessments, they should be more, not less, anticipatory--to maximize the opportunity to lay a grounding of objective, authoritative information before the subject becomes controversial.

The Congressional Office and what happens to it appears to be critical because Executive agencies will take their direction accordingly. To fully appreciate that, it is necessary to recall how the concept of

technology assessment originated. The 1960's were a time when the cumulative effects of technological advance burst into public consciousness in the form of alarms over alleged hazards to health and safety from industrial byproducts or unexpected physiological effects of chemicals such as thalidomide. Rapid economic growth and a national program of highway and airport building suddenly intruded into the suburban sanctuary of the affluent middle class, bringing pollution, noise, and competition for residential land. In the cities Black and ethnic communities, newly politicized, began to resist disruption of settled neighborhoods. Court battles resulting in costly delays to projects, and aroused constituent pressure, brought response from Congress--new requirements for planning, community participation, agency coordination, and, above all, demands that Congress be furnished with more comprehensive information. The development of technology assessment as an interdisciplinary, policy-oriented class of studies was one result. A closely related result was the National Environmental Policy Act and the requirement for environmental impact studies. I found in the survey which I mentioned that executive agencies--reacting to these demands--in the ensuing five-year period began significantly to broaden the processes by which they plan, program, and evaluate technological projects, although the extent and pace of improvement varied considerably from agency to agency. This improvement is clearly a defensive reaction to Congressional, and ultimately to public, pressure. There has been little or no pressure for better management from the top echelons of the Executive branch and there is not likely to be. Hence the agencies--the only possible source of sustained funding for T.A.--will take their lead from the Congressional OTA and take

its activities as a model or a challenge.

Rumors are circulating widely, and I believe they are well-founded, that the Office of Management and Budget has directed Executive agencies to minimize the direct support they give to OTA. Presumably this is a direct effect of the political problem I have already mentioned, i.e., the Presidential potentiality of the Chairman of the T.A. Board, although I believe the reason given is that OTA might "raid the research budget" of the agencies. If these rumors are true, the effect may nevertheless be minimal, because the agencies have not only to defend their budgets and programs to OMB but to Congress. In the present situation in Washington, the Executive Office is not able to keep as strong a hand on the bureaucracy as it could a short time ago.

In the last two years there have been small but significant signs that some agency officials believed Congressional pressure would continue. From time to time RFP's appear in the Commerce Business Daily with the words "Technology Assessment" in the description and solicitations for evaluative studies commonly use the phrase "including social impacts." The AEC now has at least one employee with the job title "Technology Assessment Specialist." The Federal Highway Administration uses the acronym "SEES" or "social, environmental, economic impact studies." The Department of Commerce has a "Technology Assessment Office" (in fact a misnomer), and most of the agencies have had conferences, seminars, or requested briefings on technology assessment for their staff. This protective reaction, it seems to me, comes almost entirely from the middle management echelons where program justification and defense must be prepared, and is resisted or ignored by the upper echelons and the lower operational echelons respectively. In a number of other agencies, there are on-going

studies which constitute technology assessments. To mention only a few examples: There is the major study proceeding in DOT, Climatic Impacts of Atmospheric Pollution, which has a broader scope and greater depth than its title might suggest. DOT is also studying the impact of alternatives to the internal combustion engine, and the impacts of railroad electrification. The Environmental Protection Agency is studying the potential impacts of electric automobiles on the Los Angeles area.

The National Science Foundation, chiefly through the Office of Exploratory Research and Problem Assessment within RANN, is still the only source of sustained funding for comprehensive technology assessment within the Federal government. This is in fact probably the best site for this activity. One of the recommendations which emerged from my study of Federal T.A. was that, while all agencies should be pressed to incorporate T.A. concepts and techniques in their day-to-day planning and evaluative procedures, comprehensive and credible T.A.'s were best sponsored by a source which had no operational responsibility for the programs and projects being assessed, in order to provide a broad scope for potential assessments, reduce institutional bias and maximize public access to the results. NSF had $2.1 million for T.A. in FY '74 and expects to have $2.7 million for FY '75. The range of topics in which NSF has funded technology assessments is broad...

- alternatives to the internal combustion engine
- solar energy
- geothermal energy
- off-shore oil and gas exploitation
- energy conservation measures

- weather modification (snowpack augmentation)
- integrated hog farming
- biopesticides
- conversion to the metric system
- alternative work schedules
- remote sensing
- videophone
- cable television
- electronic banking

NSF has also funded some supporting work in T.A.: the survey which I conducted in Federal agencies, the comparative study which Martin Jones has described,[2] another survey of technology assessment activity including the state and local and private sector, four studies of priorities for T.A., and several workshops and conferences on technology assessment.

There are several additional points to be made here.

NSF has apparently decided not to fund further studies of a strictly methodological nature, but to encourage experimentation with a variety of techniques and methods appropriate to the technology being assessed--in other words, to let the configuration of the technology drive the research design.

The techniques of technology assessment are considered to be equally appropriate to social technology as well as physical and biological technology; note that alternative work schedules is a social technology, and that several of the other subjects (the metric system, integration of hog farming) have important elements of both physical and social technology.

While none of the areas picked by OTA for its first year is purely a social technology, Mr. Daddario and Mr. De Simone have stated that they

expect to choose such areas in the future.

Nearly every technology assessment which has been done reached a similar conclusion either explicitly or implicitly--namely, that institutional obsolescence, maladjustment, or inadequacy is critical in problems arising from or foreseen for technological development; or that new institutional arrangements must be invented in order to direct or control the direction of development or minimize undesirable side-effects.

Even when sponsors of assessments have explicitly directed the performers not to make policy recommendations, such findings seem inexorably to emerge. Some organizations and researchers have refused or resisted the opportunity to carry out the logical final steps in technology assessment considered as support for policy making--that is, to lay out policy and action alternatives and assess their comparative impacts. It is often claimed that such tasks intrude the "values" of the assessor into the decision-making process. But technology assessment is intended to support and inform the decision-making process, and the public cannot be expected to understand, nor the decision-makers to have the time, to penetrate a dense technical report and work out the implications for alternative policies and actions in order to make a wise choice. Either the assessors themselves must draw out and elucidate these alternatives (without intervening in the final decision) or some other entity such as OTA must provide the translation. NSF has recently required that a substantial portion of the funding be allocated to providing a popular version of the technical report which is both accurate and easily readable by the layman, and to providing a plan for popular dissemination of results through publications, filmstrips, broadcast

media, and open conferences. This is a substantial and significant departure for NSF, which in basic research grants can rely on scholarly publications and peer group interest to get research results to users.

An interesting trend has developed in would-be contractors and grantees responding to NSF program announcements and to some extent to competitive solicitations for assessments by other agencies: the formation of consortia of universities, or of universities, non-profit and profit-oriented research organizations, and industry research and development units. Most organizations cannot within themselves meet the requirements that more and more become apparent as experience with technology assessment accumulates.

It is interesting that industry, which has not rushed to perform or sponsor technology assessments of technological developments which it may be pushing, should respond to Federal initiatives. Those companies which have done so usually have a potential interest in the potential technology being assessed, and evidently saw this as an opportunity to perform an assessment and gain valuable information which the corporate structure would not be willing to pay for (and even make a slight profit to sweeten the deal), but also saw it as an opportunity to learn a skill which it may be necessary to possess in the future. In many cases the industry group chose a University research team as subcontractor or joint participant. In all likelihood the sponsoring agency will get full and valuable return on this investment by tapping into expertise and experience (in the technology) which industry has in abundance. The University teams on the other hand have a queasy foreboding that--having absorbed the knowledge and experience the University group has developed in assessment--industry will go it alone the second time around and

attract the lion's share of future T.A. funding.

Technology assessments should (a) be widely interdisciplinary, (b) include or have access to both data from advanced basic research and experienced applied, problem-oriented researchers, (c) be free of the taint of or suspicion of institutional bias, (d) be protected from pressure by client, constituents, political activists, (e) be well-managed and coordinated, and (f) be sensitive to the real needs of the ultimate user (who often does not know his needs). To have the desired impact (that is, to be in a position to support and inform decision-making) technology assessments should also have credibility, visibility, and a means of communicating the findings to the public.

Interdisciplinary research is and has always been a problem for universities except in extraordinary circumstances. The chief difficulties, as Jack White has pointed out,[3] are the reward structure and the inability of experts in one field to communicate information and insights to experts in other fields, especially where the disciplines differ widely in assumptions, theories, methodology, terminology, and acceptable degree of uncertainty. The reward structure for interdisciplinary studies of the T.A. type is slowly improving. In part this is a result of the emphasis on relevancy during the past decade, but its practical manifestations are the emergence of interdisciplinary journals (offering the opportunity for publication), the development of interdisciplinary degree-granting programs (job-opportunities, promotions, and prestige), a growing opportunity for consultantships for social scientists, experienced "generalists," and applied methodology experts. When, as has been the case with the University of Oklahoma's off-shore oil and gas assessment, the study receives wide attention from Federal agencies and Congress, a new (for academics) reward

structure comes into play. It is noteworthy that large independent research organizations appear to have their own difficulties with interdisciplinary studies, a point not often recognized. Internal organization of any information-oriented bureaucracy (as good a definition of both universities and research organizations as can be found) seems to have an irresistible tendency to harden along disciplinary lines. This probably results from the fact that advanced knowledge and training becomes ever more specialized. There is probably no way to overcome this tendency except by interdisciplinary training, or, more likely, interdisciplinary experience on the part of more scientists. Social scientists are usually poorly educated in natural sciences, even in an understanding of the physical laws of the world they live in ; physical scientists seem to have two parallel deficiencies: an inability to deal intelligently with uncertainty and low probability, and an inadequate understanding of how people react with, and use and misuse, technology.

Universities have an even more serious problem. Theoretically they can draw on a wide range of disciplines, and have an advantage over independent research organizations in that they do not become constricted to those areas well supported by long-term clients, but they almost invariably lack management capability. Management of a university interdisciplinary research team should not be located within one of the participating departments, but should be outside of the academic structure and supported by a core staff which is not tied to the vagaries of the university teaching calendar; even so, by the nature of the beast, to the extent that it utilizes faculty and students (and is not simply a think-tank grafted onto the university) authority and discipline, to impose coherence and deadlines, will still be difficult. The University, on the other hand,

has some additional advantages for technology assessments--it can provide ready access to basic research at the developing edge of a science or technology; it generally enjoys both the substance and the reputation for objectivity and neutrality; it can exploit trained personnel (graduate students) at outrageously low costs with good conscience since it is offering them a valuable commodity in return, real world experience and a chance to build a track record.

The role which public participation should or can play in technology assessment is not yet resolved. (Here I am not raising a question as to the role of public participation in decision-making; that it must and can play such a role is indisputable.) But technology assessment is not decision-making--its function is to provide an objective base of information for decision-makers--as nearly complete and neutral as human capability can aspire to. Some argue that public participation is also vital in that step, to ensure that all affected parties and all potential impacts are detected and evaluated. Others would argue against that proposition on the grounds that

- "the public " by definition can add nothing to, and lacks the specialized knowledge to evaluate, the scientific and technical knowledge that must be brought to bear <u>during</u> the analysis;

- public participation converts the analytical process into an adversarial process (or political process) which consists of balancing or weighting obvious interests rather than detecting and tracing unsuspected impacts;

- the interests represented will be only short-term and narrow interests; since no one speaks for the community or society as a whole or for the long-term future, such concerns will be outweighed and downgraded;

- public participation generates and solidifies opposition (or support) too early in the evaluative process, before sufficient data is available; later information tends not to overcome the political and psychological "investments" already made (i.e., minds are difficult to change);

- some segments of society can rarely or never be involved in "public" participation; also, assessors may make biased choices of the "public" who are to participate, or may co-opt their support for later implementation.

The development of technology assessment, in which the U.S. has led the way, is not a national but a multi-national development. Several international conferences have been held, bringing together those interested in technology assessment in both industrial and developing countries. Groups of government, industrial, and academic representatives from western and eastern Europe, Scandinavia, and Japan frequently visit the U.S. to discuss technology assessment. The International Society for Technology Assessment, which held a major conference in The Netherlands last spring, is now planning a more specialized conference in Tokyo in conjunction with the Japan Techno-Economic Society. OECD has an international group actively studying technology assessment. One of the most promising trends to be noted is the way in which assessors and planners in many countries with different forms of government, legal systems, ideologies, and economies are experimenting with the same techniques and methodologies and grappling with the same problems--such as how to communicate and make the results of assessment more useful to decision-makers, how to develop scenarios of the future in which technological impacts will be manifested, and how to deal with and manage the inevitable uncertainties of assessment. What is emerging here is a kind of cooperative effort which transcends language, politics, and ideology in an effort to come to grips with common practical problems.

I have said that what happens to the U.S. Congressional Office of Technology Assessment is a critical factor in the behavior of Executive Agencies, but I do not mean that it will be the determining factor in the further development of technology assessment. That development, as a practical and useful, albeit only a first and uncertain, approach to dealing with the problems of increasingly complex society, is not only "an idea whose time has come," but an idea which is logically inevitable.

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1. Vary T. Coates, Technology and Public Policy, Summary Report (Rept. No. NSF/RA/X-72-003S, July 1972). A Study performed at The George Washington University Program of Policy Studies in Science and Technology, for the National Science Foundation. Available through NSF, Office of Exploratory Research and Problem Assessment.

2. Martin V. Jones (Director, Impact Assessment Institute, Bethesda, Md.), "Technology Assessment: A Framework for Comparison," Paper presented at the Annual Meeting of the American Association for the Advancement of Science, San Francisco, February 28, 1974 (Sessions on Science and Public Policy).

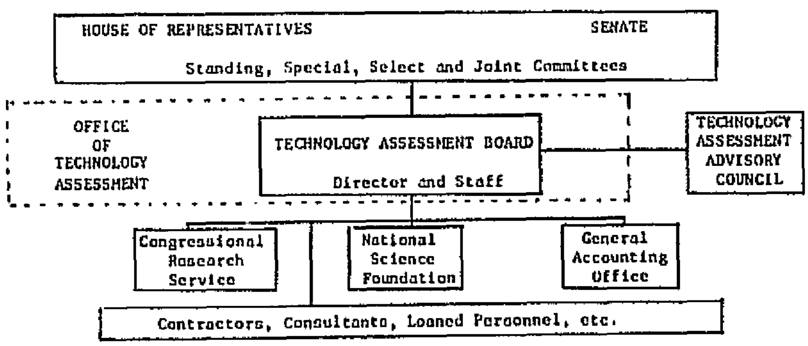
3. L. (Jack) White (Science and Public Policy Program, University of Oklahoma), "The OU Technology Assessment of OCS Oil and Gas Operations," Paper presented at the Annual Meeting of the American Association for the Advancement of Science, San Francisco, February 28, 1974 (Sessions on Science and Public Policy).

TECHNOLOGY ASSESSMENT BOARD

	Republicans	*Democrats*
Senate	CASE (N.J.)	KENNEDY (Mass.)
	DOMINICK (Col.) *	HOLLINGS (S. Car.)
	SCHWEIKER (Penn.)	HUMPHREY (Minn.)
House	MOSHER (Ohio)	DAVIS (Ga.)
	GUBSER (Calif.)	TEAGUE (Tex.)
	HARVEY (Mich.)	UDALL (Ariz.)

* Senator Stevens of Alaska has been appointed to replace Senator Dominick, who resigned from the Board.

ORGANIZATIONAL RELATIONSHIPS



TECHNOLOGY ASSESSMENT BOARD
CONGRESS OF THE UNITED STATES

November 29, 1973

RESOLUTION ON APPOINTMENT OF
TEN PUBLIC MEMBERS TO ADVISORY COUNTIL

The Chairman is hereby authorized to effect the appointment of the following ten public members to the Technology Assessment Advisory Council:

Harold Brown	President California Institute of Technology
J. Fred Bucy	Executive Vice President Texas Instruments, Inc.
Hazel Henderson	Author and lecturer on environmental and social issues
J. M. (Levi) Leathers	Executive Vice President DOW Chemical Corporation
John McAlister, Jr.	Associate Professor Department of Engineering-Economic Systems Stanford University
Eugene P. Odum	Director Institute of Ecology University of Georgia
Frederick C. Robbins	Dean Case Western Reserve University School of Medicine (Nobel Laureate)
Edward Wenk, Jr.	Professor of Engineering and Public Affairs University of Washington
Gilbert F. White	Director Institute of Behavioral Science University of Colorado

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III. INSTITUTIONALIZATION OF TECHNOLOGY ASSESSMENT

H. Technology Assessment and Citizen Action

Ellis R. MOTTUR

March 1971, pp. 10-26

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III - THE NEED FOR CITIZEN ACTION

It is believed that the national assessment system sketched out above would afford a feasible framework of institutions and mechanisms, within which the assessment process could proceed effectively -- provided that the essential element of citizen participation is forthcoming to the extent necessary for assessment to reflect the underlying needs and demands of the society. Technology is interwoven throughout the fabric of our society; yet as widespread as is its role today, its potential range of ramifications is likely to be even more extensive tomorrow. As war is said to be too important to be left to the generals, so technology assessment is far too crucial to the shape of our future to be left to the professional assessors and the special interest groups involved, regardless of how excellent their qualifications or how altruistic their objectives may be.

The world of tomorrow will be increasingly a technological society. Technology assessment -- regardless of how recondite its details may be -- must become an integral aspect of the nation's total social, political, economic decision-making processes, in which all citizens have the opportunity to participate. Otherwise, in a technology-permeated society, it will become increasingly difficult -- if not impossible -- to maintain, much less enhance, the democratic character of our society and the quality of freedom in our lives.

Hence, citizen participation must be an absolutely essential aspect of the assessment process. There are innumerable impediments, however, which stand in the way of citizens' taking effective assessment action. These impediments fall in three interrelated areas: (1) finance,

"The judgment then converts what the economists call a "social" cost into what the economists call an "enterprise" cost. It internalizes the so-called external cost. In a similar way the legal system can maintain the incidence of a cost by declining to recognize a cause of action in tort against the company.

"Through tort law, the legal system operates directly upon the incidence of costs. Through the law of contract, the legal system may operate indirectly upon the incidence of costs. Contract law may enable the persons involved to adjust or modify the incidence of a cost by giving effect to agreements among them designed to effect such an adjustment. On the other hand, contract law may frustrate efforts of the persons involved to modify the incidence of costs by declining to give effect to agreements among them designed for such a purpose.

"In the long history of the common law in America, changes have occurred from time to time affecting the incidence of costs. Changes have also been made by legislation, such as industrial safety and accident legislation and workmen's compensation laws. Comparable changes may occur in the future in the continuing evolution of the law in response to the changing realities of American life.

"Let me take a moment to hammer the point home. When is it a good business proposition to put something on the market? From the point of view of the business enterprise, it is a sound step if the product to be marketed will make money. I want to emphasize first, that the enterprise's own estimate of anticipated income and expense takes for granted the existing provisions of the legal system; second, that the existing provisions of the legal system at any time are the result of a long evolution; and third, that the legal system in America continues to evolve. Any changes which you gentlemen may make through new legislation will become part of this continuing evolution. You would not be altering the basic structure of the legal system nor of the business system. You would be altering the incidence of costs whose incidence has been altered before in the evolution of the business and legal systems."

H -- The final element in the nation's assessment system is the essential role of citizen participation, the topic to which the remainder of this paper is devoted.

(2) organization and motivation, and (3) information. Each is treated in turn below.

(1) Finance. With rare exceptions, individual citizens do not have the financial resources to enter deeply into the assessment process as individuals. Those who are professional experts in a particular area can often express their assessment views in the open literature, in Congressional testimony, or as expert consultants. But apart from this group (which is generally quite small relative to any particular issue), and from the even smaller group of extremely wealthy individuals who make a practice of espousing causes, individuals as such cannot play a significant role in the assessment process, except through exercising their power of choice in the operation of the market or political system.

By joining together in groups, citizens can, of course, exert a much greater influence, depending on the size of the group, its financial resources, and its cohesiveness with respect to the issues under contention. We are all familiar with the divers conservation, environment, and consumer groups which have been proliferating in recent years, not to mention the various political action groups which have been emerging recently in response to issues such as Viet Nam, civil rights, etc.

One problem common to almost all such groups is inadequate financing; fund raising is usually a persistent problem, and much of these groups' energy and effort is generally devoted to replenishing their depleted coffers. This lack of money imposes severe limitations on the influence such groups can exert, especially vis-a-vis well-financed special interest groups with which they may be contending, either for broad public support or for Congressional decisions.

Effective citizen participation in the assessment process requires new financial mechanisms whereby such groups can obtain the necessary funds, on a continuing basis, to compete on an even-footing with the well-heeled special interests. Part IV of this paper, below, presents a specific proposal for meeting this financial problem.

(2) Organization and Motivation. The problems of launching such groups, of organizing them for effective action, and of motivating citizens to join them and to support their efforts are intimately intertwined with one another, and are all dependent on meeting the essential financial prerequisites. For example, consider the problem of motivation. This problem does not apply to the initial formation of the group, by a small number of highly motivated individuals, but rather to the difficulties involved in motivating large numbers of members to join and actively support the group's programs. Assuming that the group addresses a real need in our society and has some inherent appeal for some segment of the public, then the problem becomes one of proper promotion of the group's objectives and programs and the values associated with membership. This in turn resolves into a financial problem: if sufficient seed money is available, then an effective promotional campaign can be mounted and additional members obtained, who in turn generate additional funds.

The problem of organization is similarly dependent on financial considerations. Many such groups are reported to be relatively inept at developing a strong internal organization and at structuring their external relationships with executive agencies, the Congress, the public-at-large, or other specific groups they may wish to influence. But I suspect that whatever ineptness there may be, in fact, is probably due far more to

limitations in funds than to any lack of potential for the pragmatic exercise of power. One may certainly cite examples of highly successful efforts supported with meagre financial resources. (Ralph Nader, of course, started out by himself; and even today I doubt whether the powerful 'machine' he leads is exactly affluent, especially vis-a-vis the interests he and his adherents are opposing.) But the fundamental point, I think, remains valid: that given a group with inherent appeal to some segment of the public, the problems of motivation and organization are largely dependent on the financial resources which can be obtained.

(3) Information. While the problem of obtaining and utilizing information effectively is also dependent in large part on the availability of adequate financial resources, there are also research problems and time delays involved here which are of crucial importance. For example, one may know that the dumping of industrial wastes into bodies of water has deleterious consequences, without knowing the nature and extent of those consequences, or the relative damage contributed by particular components of the overall mix of industrial wastes. Answers to such questions, however, are frequently extremely important to the design and implementation of practicable anti-pollution programs. Yet obtaining valid answers often requires extensive research, and the research in turn entails time and money.

The difficulty of obtaining adequate information is further complicated by the fact that many of the consequences of technology, beneficial as well as adverse, do not occur -- at least sufficiently so that they can be identified -- until considerable time has elapsed, and vast resources have already been irretrievably committed to particular courses of action.

Once such resources have been so committed, powerful special interest groups are generated with the objective of maintaining and enhancing their stake in the technology under consideration.

In view of this situation, the performance of adequate technology assessment entails the incorporation of an 'early warning' capability which can identify such problems well before they arise, and before the related patterns of resource allocation have been cemented in place. The development of such an 'early warning' capability requires a great deal of additional research and experimentation in such areas as technological forecasting, social indicators, and the application of systems analysis to social and behavioral problems. Society still has a long way to go in devising appropriate 'early warning' techniques.

In addition, there is a corollary capability which must be developed if 'early warning' efforts are to prove of any avail. This is the capability to take appropriate action, after society has been duly forewarned. In certain limited areas, there are some existing mechanisms directed at this objective. For example, if a food additive is shown to induce cancer in a test animal, its use is prohibited. Similarly, if tests of new drugs show them up as ineffective, or as yielding adverse consequences which outweigh their positive effects, the drugs can be prohibited. Thus in a few areas, there are mechanisms, however imperfect they may be, for implementing the results of 'early warning' research. In the vast majority of instances, however, in which technology can impinge on society and human life, there are no adequate mechanisms for acting upon 'early warning' results. Thus, for example, if a new type of container material were developed today which research indicated would come to constitute a serious

environmental pollutant two decades from now -- after certain quantities had accumulated and certain chemical changes had occurred -- there would be no way of halting production, short of new legislation specifically aimed at that product.

Another approach to the problem would be general legislation calling for a vast expansion in government regulatory control over industrial operations and products. This would be bound to have an inhibiting effect on the rate of technological innovation and would probably dampen the overall vigor of the economy. At the same time it would go a long way toward radically altering the balance of power in the country between the Federal Government and private enterprise. In any event, it is not an approach likely to achieve widespread support and enactment in the foreseeable future.

The fundamental problem remains, however, for technology assessment to prove effective, society must have the research capability to perform the 'early warning' function, as well as the implementation mechanisms whereby such warnings can be acted upon before it is too late.

We can summarize the requirements for effective citizen action in the assessment process as follows: Society must afford existing and prospective citizens groups the opportunity to obtain adequate financing on a continuing basis. With such financing, citizens groups can motivate their potential membership to join and participate, and can organize themselves for effective action. They can also use the financial resources to obtain the necessary base of information to further their causes, supporting the performance of research when necessary. Furthermore, as the 'early warning' capability is perfected, they can assess the future consequences of current

and projected technologies. Finally, as mechanisms are developed whereby society can take prompt action in response to the results of 'early warning' research, citizens groups can come to exert the extensive influence they deserve to wield in shaping the course of the future.

IV - CITIZENS ASSESSMENT ASSOCIATIONS: A PROPOSAL FOR ACTION

A -- General

The following proposal has been designed to meet the objectives outlined above. It does not purport to be a finished end product, but is put forth as a preliminary proposal solely to serve as the basis for further thought and discussion along these lines.

The proposal calls for the establishment of Citizens Assessment Associations whose functioning would be fostered and regulated by a new Federal agency, the Citizens Assessment Administration. Through the financial mechanisms described below, the CAA's would be enabled to obtain adequate funding on a continuing basis, which would provide them with the essential financial resources required to assert significant influence in the assessment process. With this financial base, they would be able to promote their objectives and activities, motivate sufficient numbers of their potential membership group, and organize themselves for the effective exercise of influence on the assessment process. To cope with the important information requirements for effective assessment action, they would be empowered to assemble, process, and analyze information relevant to their assessment topics; and whenever necessary to conduct or commission necessary research relevant to their assessment areas.

When CAA's had accumulated and analyzed relevant information needed to perform the desired assessments, they would be empowered to disseminate the results of their assessments to the public-at-large, as well as to appropriate decision-making organizations within the society (Congressional Committees, Executive Agencies, etc.). They would thereby perform a public information function, as well as be in a position to lobby for legislation or executive regulations in keeping with their findings.

In addition, however, they would have the extremely important power to institute legal, class action proceedings against any organization or individual within the society (including agencies of Federal, state, and local government), which were making use -- or planning to make use -- of technologies whose assessments indicated detrimental consequences to the persons or interests of certain segments of the public. These functions of the CAA's, along with their facilitating mechanisms, are discussed in turn below.

B -- Citizens Assessment Administration

This would be an independent government agency with its Administrator reporting directly to the President. The Administrator would formulate and carry out the policies of the agency within broad guidelines laid down by a Citizens Assessment Board, whose members would be appointed by the President, and who would represent a wide spectrum of interests in American society.

The CAA would be responsible for developing criteria for, and regulating the establishment and functioning of, Citizens Assessment Associations. In addition, the CAA would administer various financial

measures (described in the section on Financing below), which would be designed to protect the viability of Citizens Assessment Associations. (Although there are many substantial differences, the relationship of the Small Business Administration to small business firms can be thought of as somewhat analogous to what is intended here.)

C -- Establishment and Organization of CAA's

Any group of citizens, meeting the criteria set forth by the CAA, could establish a new Citizens Assessment Association. In addition, existing non-profit organizations could be converted into CAA's, if they meet the necessary criteria. The purposes for which a particular CAA if formed could be as broad as 'protection of the environment' or as narrow as 'assessment of consumer products containing asbestos.' The specific purposes would be spelled out in the CAA's incorporation charter within quidelines established by the CAA. The initial financial support for CAA's could come partly through individual donations and membership dues and partly through foundation grants or government grants and contracts. In addition to these currently available sources of funds, CAA's would also have the new mechanism available of issuing Citizens Assessment Bonds (described below). These bonds would provide CAA's with the continuing financial stability essential to making a real impact on the assessment process. Once established, the new CAA would be empowered to use a portion of its funds for promotional purposes to sell more Citizens Assessment Bonds and to increase its membership. There could be different classes of membership and voting rights depending on whether an individual or affiliated organization made a contribution, paid dues, or purchased a CA Bond. (The CAA agency would have to regulate these matters carefully to

preclude the seizure of control of a CAA by contending economic interests, e.g., the purchase of a controlling amount of bonds in a CAA oriented against oil spill pollution by the oil industry.)

D -- Functioning of CAA's

The primary purpose of each CAA would be to perform technology assessments in its areas of interest, or to draw upon assessment results obtained by others; and to utilize those results to affect the decision processes regulating society's use of the technology or technology-based system under consideration.

To accomplish that purpose, each CAA would have inhouse, or available to draw upon, a capability for arriving at assessment judgments. Thus the CAA could have its own staff and/or advisory council of assessment authorities who would form the assessment judgment upon which the CAA would act. Or the CAA could draw upon available results of assessments by groups such as the National Academies of Science and Engineering; or contract with universities or research institutes, to carry out specific assessment assignments. When further research was required before an assessment judgment could be formed, the CAA could similarly carry out such research inhouse, or contract with others for its performance.

Regardless of which of these patterns was followed, the CAA would arrive at an assessment judgment upon which it wished to act. (Since the essence of the CAA concept is citizen participation, there should be provision in the agency rules regulating CAA's that such assessment decisions must be duly ratified by the CAA's membership before they can be accepted and acted upon. This would help preclude the CAA's from being subverted into elitist, expert-dominated organizations.)

Upon acceptance of an assessment, the CAA could follow one or more of a number of possible courses of action.

(1) The CAA could disseminate its results publicly and attempt to influence overall public opinion, or the views of selected segments of the public.

(2) The CAA could lobby directly (or indirectly through other lobby organizations) with Congress, state legislators, government agencies at, Federal, state, and local level, the White House, governors, influential private organizations and individuals, etc. The purpose of such lobbying would, of course, be to induce the target group to accept the assessment results and take appropriate action on them.

(3) The CAA could institute class action, legal proceedings on behalf of its membership and other potentially affected parties. These legal proceedings could be directed at any organization or individual in society (including agencies of Federal, state, and local government when appropriate), which were making use -- or planning to make use -- of technologies whose assessments indicated detrimental consequences to the persons or interests of certain segments of the public.

This power to intiate litigation includes several important components:

(a) The suits would be class action suits that would apply to whole classes of affected parties.

(b) The detrimental consequences could be either to the 'persons' or the 'interests' of certain segments of the public. Thus if it could be shown in court that it was to the interest of a certain segment of the public to maintain the beauty of a national park intact and uncontaminated, then action which would injure that park would be detrimental to the interests of the affected segment of the public.

(c) The technologies with the detrimental consequences need not be functioning already for the litigation to commence. The planned use of technologies with detrimental consequences would also be subject to appropriate litigation.

What kinds of results would ensue from such litigation? In the case of technologies which were already in operation, with attendant detrimental consequences, the courts could award damages to the CAA and associated affected parties. (In addition, appropriate criminal action could be initiated when criminal violations had occurred.)

In determining damage awards, the CAA Act establishing the agency and the associations would extend the concept of damages and associated costs to include not only real and punitive damages when applicable, and the litigation costs borne by the CAA, but also that portion of the CAA's operating costs which enabled it to prosecute the suit successfully. Thus the CAA would be entitled to be reimbursed for: (a) its own operating costs relative to the preparation for and prosecution of the suit; (b) the costs of relevant research contracts and consulting fees; and (c) an appropriately prorated portion of the interest on the CAA's Citizens Assessment Bonds. This statutory extension in the concept of damages and associated costs would go a long way toward assuring the financial viability of CAA's.

In the case of technologies whose detrimental consequences had not yet occurred, the following kinds of results would be possible. This would include technologies which were planned but not yet in being, as well as technologies in existence, whose detrimental consequences had not yet occurred, but could be scientifically forecast with some degree of confidence.

In such cases, the CAA could seek a permanent injunction to prohibit further implementation of the particular technology, as well as appropriate dismantling of what was already in being. If such an injunction were awarded (and sustained of course), the organization on whom the injunction were placed would be liable to reimburse the CAA for its litigation costs, and also for the associated costs necessary to prepare the case (as outlined above). Again this would greatly aid the CAA's in maintaining financial viability.

E -- Financing of CAA's

As noted above, CAA's would be permitted to accept charitable donations, membership dues, and grants and contracts from private and government organizations. But the primary source of their funds, and the foundation of their financial stability would be the Citizens Assessment Bonds they would be empowered to issue.

The interest rate on these bonds would be regulated by the CAA agency. The rate would be set at a higher level than that permitted on savings bank accounts, and probably somewhat higher than that permitted on bank certificates of deposit or savings and loan association rates.

Bonds would be issued for ten year periods, and interest on them would be guaranteed by the CAA agency in case of default on the part of a particular CAA.

Other sources of funds available to CAA's, besides the bonds, donations, dues, grants, and contracts, would be reimbursement for operating costs (as broadly defined above) arising from successful litigation. CAA's would redeem outstanding bonds at the end of ten year periods through these sources of funds, as well as through additional bond issues.

With these ground rules, some CAA's would undoubtedly become financially insolvent. In such cases, the remaining assets of the CAA would be distributed to the bond holders on a pro rata basis. Thus there would be some element of risk in these bonds; and it is for this reason that their interest rate would be set somewhat higher than bank savings certificates, for example.

The interest rates would not be set too high, however, because the purpose of these bonds is not to provide a desirable form of investment in general. Its purpose is instead to enable citizens who care about particular assessment issues, like water pollution or noise due to the SST, to contribute to society's resolution of the issue, at minimal risk to their normal savings.

To those who would doubt the appeal of such bonds, I would merely point out how voluntary citizens organizations have managed to survive financially without this reimbursement mechanism. With it, I think they will flourish, and citizen participation will rightly become a powerful factor in the assessment process.

F -- Balanced Approach of CAA's

Although much of the preceding discussion on the CAA has been couched in terms of the negative consequences of technology, there is nothing inherent in the CAA concept to exclude the promotion by CAA's of particular technologies with expected positive consequences. For example, a CAA could be formed to promote the development and use of electric cars, or certain systems of public transportation, or solar energy systems, etc. The purpose of the CAA concept is not to facilitate citizens' attacks on technology, but rather to enable citizens to achieve full domocratic participation in the

process of technology assessment. Without such participation, the whole character and quality of our democracy would ultimately be vitiated.

V - IMPLICATIONS OF CITIZEN ASSESSMENT ACTION

The Citizens Assessment Association concept as presented represents an institutional innovation which could prove significant. Accordingly, it is worth exploring some of its major implications.

If the CAA concept were implemented, there would probably be extensive use of class action suits. At the same time the proposed legislation would foster an extremely broad interpretation of the 'interests' of certain segments of the public. Recent lawsuits filed in the environmental area have been filed partially on behalf of future generations. While this is perhaps an extreme case of a broad interpretation of 'interests', it is nonetheless the general direction toward which the CAA concept would move litigation.

The broad interpretation of associated costs of litigation -- to include the operating and research costs of the CAA necessary to establish the assessment case -- appears to be of some legal significance. Whatever its significance, however, I believe this interpretation is absolutely essential to enable the judicial system to play the crucial role with respect to society's utilization of technology that it has played in other areas of society's evolution. For the complexities of technology are so great and the future consequences of present technological activity are so difficult to determine, that relevant research must be seen as an essential aspect of litigation on these matters.

Finally, there are the implications of using present scientific research as evidence to assert that it is reasonable to conclude that certain consequences are probable to occur in the future. For example, scientific research could well conclude that the use of a certain chemical in small doses over a period of time would cumulatively constitute a future hazard to a statistically significant segment of the population. On such grounds under the CAA proposal, an injunction could be obtained against the promoter of the chemical, with his incurring a financial liability to the CAA which successfully sought the injunction. This seems to me again to pose some legal issues of apparent significance. But I am convinced that the legal system must find a way of taking account of such considerations, if the system is to fulfill its role in a technology-centered, highly interdependent society. Put in other terms, I believe the legal system must find a way of making present determinations of fact on the basis of scientific evidence regarding probabilities of future occurrence.

As challenging as some of these problems may be to the legal community, the industrial world will also have its share of adjustments to make. The concept of imposing costs on an industrial firm on the basis of some of its planned activities, or on the future consequences of present activities which are scientifically forecast to prove detrimental, is certainly something of a radical notion. But again, I am personally convinced something of that sort is essential for society in order to control the evolution of technology-based industry in socially desirable directions -- or at least in directions which are not socially detrimental. One point is clear in this regard: if such costs were imposed on industry, firms would

certainly think much more deeply and carefully with regard to the social consequences of their actions. The 'total systems, future-oriented approach' to technology assessment would undoubtedly gain many adherents in industry!

A final implication of the CAA concept which may be cited derives from the Citizens Assessment Bonds. These bonds are predicated on the assumption that it is proper for citizens to receive a financial return (even if a modest, limited one) on relatively low-risk investments they may make, with the objective of enhancing the overall assets of society, such as environmental quality. It is interesting to ponder where such a radical notion may eventually lead.

VI - CONCLUSION

In this paper I have made a plea for the importance of citizen participation in the assessment process, and presented a proposal for an institutional innovation which would facilitate effective citizen assessment action. As I stated initially, the proposal is a preliminary one intended to generate discussion on the myriad of issues involved. It contains a number of radical concepts and mechanisms which are undoubtedly open to a number of criticisms. Nevertheless, I believe the proposal contains the germ of an idea which is worth pursuing. If recent decades have taught us any lesson, it is that the radical concepts of one year rapidly become the cliches of the next one. On one final point, I am absolutely convinced: we have to find a way of assuring effective citizen action in the assessment process if our society is to survive as a democracy -- in which the quality of individual life remains paramount.

III. INSTITUTIONALIZATION OF TECHNOLOGY ASSESSMENT

I. Technology Assessment: New Demands for Information

Vary T. COATES

November 1974

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Scope

groups, both industry and public-oriented, were urged to attend and to express their views. The extent to which the media pick up these events and publications and give them even wider public notice is not clear, but a recent controversy over the failure (so far) of the National Academy of Sciences to publish an NSF-sponsored assessment of biomedical technology was reported at length in *The New York Times.*

The Congressional OTA also has adopted a policy of open distribution of assessment results, even though its primary purpose is to serve the Congress.

Increased public response seen

One must suppose that public reaction to technology assessment reports may, in the future, parallel public response to environmental impact statements. Early statements were done more or less perfunctorily and were almost all unsatisfactory in that they set out the agency justification for planned projects and programs and were one-sided, incomplete, and often inaccurate. Improvement has come about not so much because of the review of other federal agencies or the review of the Council on Environmental Quality, but because concerned citizens seized on the statements and carried them into the courts. The courts have, in interpreting the National Environmental Policy Act, steadily broadened and clarified both the procedural and the substantive requirements of the law. For example, one court ruled that "government agencies are directed to 'utilize a systematic, interdisciplinary approach which will insure the integrated use of the natural and social sciences and the environmental design arts in planning and in decision making...'" (Memorandum opinion of Judge Gasch, *Environmental Defense Fund, Inc.* v. *Hardin*, 2 ERC 1424, 1 ELR 20207 (D. D.C. 1971).)

"TA deals with impacts. Few social impacts are spread evenly over society; some people will reap the benefits of a new technology, and some people will be hurt."

There is, of course, no law requiring technology assessment. One may conjecture, however, that data produced in technology assessment may soon be carried into court and used to argue damages inflicted or denial of due process.

Whether used in the courts or not, it seems certain that concerned citizens' action groups will not miss the opportunity to use ammunition provided by technology assessment to attack or to defend government programs in the political forum afforded by representative democracy.

Public information, however, is not the same thing as public participation. I think there is no need in this country to defend the case for public participation in decision making—directly, through voting, and indirectly, through lobbies, the agitation of organized groups, and through pressure exerted on elected officials by private citizens. In recent decades the right of the public to be involved in long range planning or in program evaluation and review has also been incorporated into many pieces of legislation. Does this mean that public participation should be incorporated into technology assessments?

The case for public participation

There are two points of view on this matter that warrant discussion. Bear in mind that technology assessment is not decision making, nor is it intended to usurp the duties and prerogatives of decision makers. TA is intended to provide an informational input into decision making, to identify potential problems, to provide data for the rational evaluation of trade-offs, to specify areas of uncertainty, and to lay out alternatives. Those who argue for public participation make the following points:

- The way in which problems are defined and alternatives identified controls the range of possible decisions. If the public is not involved early in the process it has lost the most significant opportunity to influence decision making.
- The most effective way of identifying the "affected parties"—those who will benefit or suffer—and to measure their stakes in the outcome, is to seek them out and ask them. The technological elite and the academicians are all too apt to overlook or misjudge the interests and the wishes of the ordinary citizen, especially the poor and disadvantaged.
- Technology assessors necessarily bring their own values to bear in carrying out an assessment. Public participation will bring to bear a wider range of values—since there is no such thing as "scientific neutrality," and certainly not in applied, problem-oriented social research—different sets of values must be brought into consideration.

"... it seems certain that concerned citizens' action groups will not miss the opportunity to use ammunition provided by TA to attack or to defend government programs in the political forum..."

- Since technology assessment includes, though it is not limited to, analysis of economic benefits and costs, the viewpoints and interests of industrial and financial organizations will be considered. These "interest groups" will in some way participate in the assessment; "public interest" or citizens groups should also participate.
- Assessments made by government agencies by industry, or by research groups which regularly serve these clients will always be biased toward the Establishment or the status quo.

The on-going assessment of solar energy by Arthur D. Little is the most thorough attempt to date to incorporate public participation in technology assessment. A Public Interest Group Advisory Panel (somewhat unpleasantly known as PIGAP) was established to review and criticize the assessment throughout its course, and to submit a separate report of its own. Preliminary reports [illegible] that in a number of instances PIGAP has turned up significant data overlooked by the technical team, and that in other instances it contributed to redefining the problems or to directing the investigation along lines the experts would have ignored or been insensitive to—for example, the feasibility of adapting solar heating to public housing needs.

The neutral, scientific approach

Now let's look at the arguments on the other side. Those who conceive of technology assessment as more nearly an objective, neutral, scientific activity make these points:

- T.A. is critical in just those areas, inherent in a high technology society, where issues are highly complex, data is technical and beyond the grasp of the untrained layman, and consequences may be delayed, subtle, and uncertain. The decision maker is already exposed to the conflicting interests and view-points of the public in the political process, but he badly needs expert guidance in evaluating those conflicting viewpoints and translating them into sound technologically feasible options.
- Public participation prematurely converts the investigative process into an adversary proceeding. Opinions tend to crystallize and be politicized too early, before all the facts are known and all alternatives have had fair consideration.
- Public participation is necessarily "political" in nature, that is, it tends to the weigh and balance of special interests rather than to seek out unanticipated and hitherto unidentified consequences.
- There is no "public" but rather many publics, each of which will tend to speak for immediate, short term, and already identified interests. Long range and uncertain impacts which will affect future generations, or benefits and costs which are generalized over society, may have no organized or even latent groups to speak for them, and hence tend to be overlooked or downgraded in the assessment.
- There is a constituency problem with public interest groups—neither the assessment team nor the public interest group can verify that the group in fact speaks for its self-proclaimed constituency, on a particular point or in general. On the other hand, there is also the possibility that public interest representatives may be co-opted by their involvement in an assessment.

Summarizing the debate

On the one hand, political decisionmakers, already buffeted by conflicting demands and values, need information and guidance from scientists in highly complex subject areas where they themselves are laymen. On the other hand, in the absence of public participation, the values of a technical elite, of economic power groups, and of the Establishment may come to dominate and determine public decisions before they emerge into the political arena. In either case, the ability of a democratic society to guide technological development toward its own best interest is threatened. Self-constituted, non-responsible interest groups, whether elitist or populist, may interpose an impenetrable barrier between the individual and his elected representative. This is, I believe, why reasoned, dispassionate consideration of science and public information is very much needed.

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III. INSTITUTIONALIZATION OF TECHNOLOGY ASSESSMENT

H. Evaluation of Oak Ridge National Laboratory Report on "Technology Assessment of Modular Integrated Utility Systems (MIUS)"

Louis H. MAYO, Principal Investigator

June 1975, Cha. II, pp. 1-26

D/6

PART II - FRAMEWORK OF EVALUATION

A. Evaluation Criteria for Assessment of Proposed Public Actions

We are becoming more acutely aware of the necessity for increasing our capability to control the direction and rate of social change. This requires a future-oriented policy analysis function, whatever it may be called (Technology Assessment, Anticipatory Assessment, Social Impact Evaluations, etc.). For purposes of simplification, the remainder of the discussion herein will be in terms of Technology Assessment (TA). The purpose of TA is to clarify policy and project options in terms of their full social implications in order that intelligent choices can be made by responsible public and private sector decision-makers.

The concern with technology assessment is not simply academic. Attention is invited to the National Environmental Policy Act (NEPA) of 1969 and its requirements for environmental impact statements on all major Federal actions; the policy analysis and technology assessment programs of the National Science Foundation over the past few years; and the establishment of the Office of Technology Assessment for the Congress. These actions are initial manifestations of the beginning of the institutionalization of the Technology Assessment Function. An editorial in *Policy Sciences* (1974), states in part:

> There are stirrings afoot that appear to indicate that the policy sciences may be some twenty-three years after the program's framework was laid out by Lerner, Lasswell, and others, emerging as an identifiable, respectable, even desirable professional activity. The creation of numerous training centers in universities and institutes throughout the world, the production of Ph.D.'s with degrees in policy analysis, the proliferation of journals with a decided policy-orientation, and the willingness of public and private funding sources to support and encourage these and other related activities are all propitious signs of professional development.[1]

The various entities (public and private) which have been involved in TA over the past few years have been free to exercise the widest discretion in the development of various methodological approaches. This has resulted in innumerable approaches although all have certain basic common components and operations by virtue of the requirements of the task. Such experimentation has been productive, and continuing refinement of existing methodological concepts as well as new approaches should be encouraged. However, it is essential for the social problem assessment function to become "professionalized," at least to the extent that the performance of assessment efforts can be evaluated for their adequacy, if this function is to have an appreciable impact on the public decision process. Basic to this task is the development of standards (criteria) which can be applied to measure the adequacy of performance. The TA function entails certain assumptions which are the basic characteristics for any assessment entity; that it adopt an independent, impartial stance toward the policy, concept, program, or project being assessed (as distinguished from having a stake in or a partisan interest in a particular outcome); and that it take into account, insofar as conditions permit, the full range of social consequences which will flow from the introduction of the project configuration or other action into the evolving social environment throughout the initiation, implementation and operational stages.

There are, of course, somewhat different attitudes toward the TA function. Some analysts tend to favor the "enlightment" value (the clarification of policy options) while others tend to give greater emphasis to the actual influence of the assessment on the follow-on decision. However, such differences are all the more reason why serious thinking is now required on the matter of establishing standards by which the adequacy of the performance

of particular assessments can be made. Further, some of those involved with the TA function may object to this effort toward developing criteria of performance for reason that it may tend to inhibit continuing experimentation in methodological approaches. This concern is overstated. It is now time that those involved in the TA function submit their performances to evaluation as to their adequacy. Only in this way can the TA function achieve a position of respect and influence in the public decision process. We must be completely open as to our organizational and methodological approaches. We must be willing to accept criticism and we must strive to improve our capabilities and assessment efforts in response to justified criticism. This continuous striving to achieve consensus as to the quality of analytical performance (even if often unachievable as to the relative weights to be given affected social values) is common to our scientific tradition of submitting experiemental/research findings to peer review. To a lesser but important degree, it is also the method of most recognized professions to establish criteria of performance (including codes of ethics) by which performances by particular practitioners are to be judged.

It would seem apparent that any public interest-obligated decision maker or decisional entity would desire to have an understandable presentation, an analysis utilizing recognized techniques and performed in a professionally competent manner, and as clear an appraisal as practicable of the differences in the reasonably anticipated social benefit/cost ratio (and benefit/cost distributions) of one or more of the policy options under consideration.

The general approach to the evaluation of the adequacy of a TA effort adopted herein has considerable support from other sources. A Report from the Urban Institute concludes that "many useless evaluations of Federal

programs (are) churned out."[2] Joseph S. Wholey finds that "Results are not adequately communicated to decision makers." He finds three "particularly serious" defects in federal programs which suggest deficiencies in or at least appropriate indices of adequacy for judging the performance of a TA Effort. These are: 1) Lack of definition ("The problem being addressed, the kinds of program activities intended, and the anticipated immediate and long-range impacts are not spelled out in measurable terms."); 2) Lack of clear logic (lack of demonstration that "pursuit of action A will produce impact X."); and 3) Lack of management ("Those in charge of a program do not have the authority, motivation, or understanding to act on evaluation findings"). Wholey calls for a "preassessment of evaluability" to determine whether a program satisfies the requisites for useful evaluation:

> ...that (1) objectives and planned activities have been defined in measurable terms, (2) plausible assumptions have been made linking expenditures, program, activities, and expected outcomes, and (3) policy makers or program managers are willing and able to identify specific needs for evaluation information.[3]

It is Wholey's contention that a program or project is "unevaluable" unless these requisites are met and that evaluation efforts lacking these elements will simply be "non-productive." [4]

Other scholars in the "policy analysis" field have offered suggestions which have relevance to the criteria of TA performance. For example a recent issue of Policy Sciences contains several useful suggestions. The Editorial by Garry D. Brewer recognizes the significance of considering the "sequence of decision" including 1) Invention/initiation; 2) Estimation; 3) Selection; 4) Implementation; 5) Evaluation; and 6) Termination.[5] James G. Abert applies a "roles and missions" approach to the "Policy-Making

Function in Government"[6] and defines five key functions: Planning, Analysis, Research, Demonstration, and Evaluation. With respect to Evaluation he states:

> Evaluation is the seeking out of information from an independent viewpoint not only with respect to demonstrations, but more importantly, on ongoing operating programs and activities not funded by the organization in question. The latter is a "sleeper." It can cause many problems of a political nature. It is also often difficult to achieve cooperation in cases such as this, since there is no leverage. Yet, unless such programs are included, the scope of evaluation in many areas will be far too narrow, since federal expenditures may be only a small portion of national outlays in the area in question. Examples of this are health, education, and transportation, where federal spending is relatively small in comparison to the total national expenditure. Evaluation Management implies insuring that there are sufficient resources to do evaluation; that administrative regulations and guidelines require evaluation; that there is planning for the expenditure of the available resources; that evaluation produces documentation in forms suitable for the various users of evaluation information; and that there is accountability for the effective use of evaluation resources.[7]

In his summary statement Abert emphasizes that "more attention needs to be paid to defining who does what to whom and when it is done."[8]

In their article on "The Scholar as Artisan"[9] Robert T. Holt and John E. Turner focus on a "producer-consumer relationship." They refer to the protection that consumers have under modern commercial codes for ordinary products and suggest that sponsors of studies should have a similar protection when they "purchase" the products of social scientists.[10] They state:

> Implied warranty provisions establish another principle: "Where the seller at the time of contracting has reason to know any particular purpose for which the goods are required and that the buyer is relying on the seller's skill or judgment to select or furnish suitable goods. . ." he warrants that the goods are fit for that purpose."

With respect to the enforcement of "accountability" of the scholar they say:

> By taking this side-trip to look at the guild system, we are obviously suggesting that the primary responsibility

> for enforcing appropriate warranties on works of utilitarian scholarship rests with the scholarly community itself. . . In other words, the scholarly community as a collective entity should be responsible for the quality of the data, the use of tools of analysis, and the appropriateness of the design of the product.[12]

They note the difficulties in "Policy-Oriented Research" and state in part:

> The specification of the system of variables appropriate to an applied analysis must include any variable with a social value attached that is affected by changes in the manipulated factors--a theoretical task that presents considerable difficulty. Moreover, to warrant a product as fit for a particular purpose carries with it the need to demonstrate that, in meeting the purpose, the product is not harmful in other ways. A pill, for example, could not be considered as fit for curing a common cold if it also precipitated heart attacks in a sizeable proportion of its users. _Caveat emptor_ is not an acceptable rationale.[13]

The "nature of the warranty" is treated in the following terms:

> In light of the serious obstacles confronting the social science scholar who mines the veins of utilitarian knowledge, the question arises as to what the nature of his warranty to the consumer of the product should be. Given the underdeveloped state of the methodology that is to be applied to policy problems and the assumed lack of skill on the part of potential users, it may be advisable for the analyst to be explicit about the limitations of his research for policy purposes, just as the pill manufacturer labels the bottle "Not to be taken by people who have high blood pressure." The bill of particulars might include:
>
> (1) The assumptions made in the analysis.
> (2) A discussion of the limitations of the method.
> (3) A listing of the important variables that are amenable to policy manipulation and those that are not.
> (4) A listing of the variables that may be important from a policy point of view, even though they may not loom prominently in the statistical analysis.
> (5) An indication of what the study does _not_ consider in terms of such factors as "political climate," cost-benefit analysis, etc., including the contingent conditions under which the analyzed variables operate.[14]

Erich Jantsch in his article on "Education For Design" focuses on the concept of "total human experience."[15] He is concerned with a "systems approach to total human experience and purposeful activity,"[16] and states that "Progress toward an end-state may be called improvement, or increased dynamic stability, depending on the type of evolutionary metaphor applied."[17] Jantsch utilizes the more prominent "systems" concepts:

> A holistic measure of improvement for human activity may then be the effectiveness of design in integrating human systems towards an overall performance 'ideal' of eco-systemic stability, i.e., the effectiveness of both enquiry and creation to that end, with specific indices such as flexibility and modifiability of design, propensity for self-organization and engagement of the members of the human systems, together with active motivation, openness to genuine leadership, i.e., proposals for redesign, etc. Obviously, education for design has to be geared to such measures of improvement.[18]

Jantsch views "planning" as "inherently design," stating:

> But planning in a broad connotation is inherently design. By its very nature it is dynamic, systemic in scope and based on the feedback interaction between appreciation and creative, exploratory and normative approaches. In dealing with knowledge, it is also inter- and trans-disciplinary, focusing on the organization of knowledge for the task of building human systems.[19]

Yehezkel Drer in his article on "Models For Policy Analysis And Design In Complex Systems"[20] provides a far less esoteric approach than does Jantsch and a far more relevant treatment of the evaluative function for present purposes. In brief, Dror submits "ten interdependent components of an integrated methodology" which he summarizes:

> As already indicated, this paper presents an initial meta-model for policy studies, in the form of ten interdependent components of an integrated methodology: (1) shared descriptive-explanatory and prescriptive concept packages; (2) "preferization" as the major criterion of policy studies' acceptability;

> (3) value analysis; (4) benefit-cost-risk as framework; (5) search for novel alternatives; (6) prediction and uncertainty handling; (7) multiple assumptions, models and techniques; (8) innovative methods; (9) communicability to clients; and (10) methodological self-awareness. These components are designed to serve as a guide for engaging in policy studies and as criteria for evaluating them.[21]

In the elaboration of these ten components Dror touches upon almost every notion of the evaluation of policy analysis efforts previously noted. A few points of primary interest include:

- Preferization as a primary criterion of acceptability. This criterion poses the question as to whether a given study has improved the "policy-results" for the responsible client. He also states that "responsible acceptance criteria" provide "a safeguard against essentially political and personal recommendations being presented as 'science-based'."[22]

- Clarification of the fullest meanings of the values involved in an assessment, having reference to the utility of such clarification to "legitimate value judges."[23]

- Necessity of comparing policy options in terms of "benefit-cost-risk" criteria even though "no quantification or even commensurability of difference benefit-cost-risk dimensions is necessarily assumed."[24]

- The development of "novel alternatives" or policy options when the study task-objective is amenable to such efforts.[25]

- The "adjustment of policy alternatives to irreducible risk and uncertainty through appropriate uncertainty-absorbing methods" and the "explication of relevant value judgments, such as risk preferences" and "limitation on the domain of the study's validity and explication with respect to unconsidered future contingencies."[26]

- The necessity to make "positive redundancy essential as a basic methodology: "Simultaneous use of multiple and diverse assumptions, models, languages, and techniques is necessary in all descriptive-explanatory research..."[27]

- Emphasis on communicability: "Attention to the communication problem and recognition of its importance throughout a study are therefore basic elements of the meta-model for policy studies."[28]

> The conclusion that: "A standard requirement for all policy studies should be that their methodological bases are explicated, justified and hedged."[29]

B. Basic PPS/GWU Evaluative Criteria

Members of the Program of Policy Studies Staff have drawn upon the foregoing scholars and numerous other sources to construct an evaluative framework which will be applied in this evaluation of the ORNL MIUS Technology Assessment. Three basic assessment performance criteria may be posited: 1) Interpretability (presentation of the assessment outcome or report in such form as to be understandable to the relevant decisional entity or entities and those participants who will likely affect or in some manner be affected by the introduction of a given project configuration into the evolving social environment); 2) Warrantability (authenticity of assessment methodology, logical consistency, comprehensiveness, factual confirmation of outcomes of analytical operations, etc.); 3) and Serviceability or utility of assessment outcome to the relevant decisional entity or entities and others affected (explicitness of assessment outcome, degree to which the project configuration appears to satisfy the criteria of alignment viability, utility for making comparative evaluations with alternative project configurations, etc.). Serviceability of the TA effort will usually increase with its Interpretability and Warrantability. However, in situations where the assessment entity has no control over the design of the technological systems models or of the particular project configuration (or alternative configurations) to be assessed, these being assigned or specified by the client agency, then the Warrantability of the effort may be high while the serviceability may be severely limited if, for example, the project configuration assigned for assessment turns out to be a totally inappropriate means to the specified social end. Of course, an assessment effort which better defines the problem confronting an agency is of

some serviceability. As subsequently emphasized, specificity as to the project configuration (technological system and implementing apparatus) and the relevant assessment context will normally contribute to serviceability. And serviceability will increase to the extent that an assessment clarifies "project alignment viability" with respect to the project configuration (or configurations) considered. The Adequacy of an assessment effort performance, i.e., the extent to which policy options have been clarified, can be measured by evaluating each of the conceptual/analytical/communicative operations of assessment methodology with respect to the three aforementioned basic criteria (and derivative detailed indices of adequacy as needed).

Instructions by the National Bureau of Standards to PPS/GWU in connection with the evaluation of the ORNL Report entitled "Technology Assessment of Modular Integrated Utility Systems (MIUS)" pursuant to Contract No. 5-35851 provide that:

> Major emphasis in the review should be evaluation using the basic criteria of Interpretability and Serviceability with minor attention given to Warrantability Criteria.

C. Alternative Technology Assessment Approaches

Technology Assessments may be performed in accord with any of a variety of particular methodological approaches, but most such approaches will probably assume similar basic assessment tasks: the identification of the significant effects which will result from the introduction of a given (or of alternative) project configurations (technological system and implementing institutional apparatus) into one or more projected future social environments and the evaluation of the social impacts of such effects on participants and social value-institutional processes in accord with specified concepts of social justice, i.e., schemes of social value weight and distribution. Certain characteristics

of technology assessment are normally accepted. This function is future-oriented; it is inclusive in its consideration of effects; and it is explicit with respect to the postulates, assumptions, and methodological techniques employed. These characteristics are consistent with the ORNL Report which states: "Contrary to the implication of the title of the report, the evaluation does not focus on technology but rather on the consequences of its application." ( ) Some practitioners also place great emphasis on the assessment function as a means of providing an "early warning" device for undesirable effects, particularly the "higher order" or remote and indirect consequences of a particular technological project. Stress is here placed on the point that technology assessment seeks the clarification of policy options confronting the responsible decisional entity.

Numerous approaches to technology assessment have been developed and utilized with varying degrees of adequacy. The Task-Objective of the proposed assessment whether given by the sponsoring entity or posited by the assessing entity has a great deal to do with the technical assessment approach adorced.

The basic concepts and analytical operations noted above are common with most assessment methodologies although the terminology may differ somewhat. Frequently, in assessment situations where the task-objective is focused on the general applications of a new technology the assessing entity will identify and define one or more "systems" using the technology for purposes of showing how it might be applied to various tasks or perform under different contextual conditions. Such dimensions of the assessment methodology as social environment, relevant participants including authoritative decisional entities, legal/institutional processes for implementation and operation, funding arrangements, administrative structures, and other essential implementing components will be analyzed in terms of available options without any necessary relationship to any particular

technological system proposed to serve a carefully defined social environment. Hence, the effects emerging from the application of this technology and the social impact evaluations of such effects will also be discussed, perhaps comprehensively, in categories of possible effects rather than the effects to be anticipated from a particular application in a precise social setting. The responsible mission agency then will have available data from which it can design numerous combinations of specific project configurations for promotion and implementation. (See Part III-D re Section 3 of the ORNL Report for a variation of this approach.)

The second approach to assessment may be employed in those situations where the task-objective is focused on the assessment of well-defined project configuration (a specific technological system and the necessary implementing apparatus required to place the system in operation to perform a specified task in a precisely defined social environment). In such instances, all components of the project configuration are linked or combined so that the full scope of effects which will flow from its introduction can be rather precisely identified, measured as to probability and magnitude, and evaluated by one or more relevant social justice (social value weight and distribution) schemes. Put otherwise, a particular option has been selected with respect to each of the essential and controllable design components of the project configuration. Assessments of this type can normally be performed in a manner which will be highly serviceable to the interested implementing agency, at least with respect to the likely total social benefits and costs (and the distribution of benefits and costs) which will be associated with the authorization, implementation, and operation of the project configuration.

Frequent references will be made in the PPS/GWU Evaluation to this distinction between an "open options" approach and the more precise project configuration

assessment task. It is obvious that the technical assessment methodology will vary to some extent with these two approaches reflecting the generality/specificity of assessment concepts and analytical techniques employed.

The ORNL Report is specific as to the basic methodology selected for its conceptualization and analysis of the MIUS technology. This "procedure" is set forth as follows in §2.2:

Step 1 - Define the Assessment Task

Establish scope (breadth and depth) of inquiry

Develop project ground rules

Step 2 - Describe Relevant Technologies

Describe major technology being assessed

Describe technologies competitive to the major and supporting technologies

Step 3 - Develop State-of-Society Assumptions

Identify and describe major factors influencing the application of the relevant technologies

Step 4 - Identify Impact Areas

Step 5 - Make Preliminary Impact Analysis

Step 6 - Identify Possible Action Options

Develop and analyze various programs for obtaining maximum public advantage from the assessed technologies

Step 7 - Complete Impact Analysis

Analyze the degree to which each action option would alter the specific societal impacts of the assessed technology discussed in Step 5.

In the Introduction to the ORNL Report (Section 1) it is stated that a number of questions need to be addressed in this assessment of the comparative

social benefits and costs of substituting MIUS installations for conventional utilities in certain developmental situations:

1) What technologies are currently available for use in MIUS?

2) What technologies are likely to be available in the next two decades for use in MIUS?

3) How is MIUS likely to be applied and what type systems is it likely to replace?

4) What would be the likely primary consequences of application of MIUS, such as reliability of service, cost, and environmental impact?

5) What are likely higher order impacts - economic, psychological, social?

6) What community or interest groups are most likely to be affected by the anticipated impacts of MIUS and are most likely to take action to influence these impacts?

7) What are the most likely institutional problems and solutions to those problems?

8) What benefits and costs are likely to accrue from government efforts to alter either the application of MIUS or its subsequent consequences?

PPS/GWU conducted its Part III, Preliminary Evaluation of ORNL Responsiveness to HUD, against the above "procedure" and the specific questions the ORNL assessment undertook to address as noted in §2.2. The following basic questions were considered of relevance in this connection with respect to each major section of the ORNL Report:

1) What did ORNL propose to do in terms of the concepts, questions and tasks it undertook explicitly to perform?

2) How well did ORNL perform the proposed tasks with reference to the assessment methodology selected and the questions and tasks posited to be addressed?

3) What were the more obvious areas of adequate performance and what were the more obvious deficiencies in the execution of the questions and tasks posited to be addressed?

4) How adequately does each major section of the ORNL Report serve to relate to or support other major sections of the Report?

5) How adequately does the ORNL Report, overall, contribute to the clarification of MIUS model options for the purposes of HUD policy/decision-making in terms of Interpretability, Warrantability, and Serviceability?

Part IV of the PPS/GWU review relates to the Analysis and Evaluation of the Adequacy of Particular Aspects of the ORNL Technology Assessment of MIUS. This part of the PPS/GWU Evaluation goes to the "normative specification for an adequate assessment of MIUS" and hence does not adopt the ORNL methodological approach as the sole measure for an evaluation of the adequacy of the ORNL assessment effort. The Part IV review draws upon other study reports assessing the MIUS as well as alternative approaches to technology assessment as evaluative standards by which to measure the performance of particular aspects of the ORNL effort.

By broadening the range of assessment performance evaluative criteria for the Part IV PPS/GWU review beyond the limited scope of Part III, experience can be drawn upon and insights gained which should enhance the utility of the PPS/GWU review to all interested parties. Contract No. 5-35851 requires that the three aforementioned basic criteria of evaluation be employed in this review and then states:

> Interpretability criteria shall be utilized to determine whether the document's format and content allows an intended user to properly interpret the operation of the Technology Assessment effort, the relative attainment of the task objective and the assumptions, social problem context, limiting constraints and areas of uncertainty encountered in the effort.
>
> Warrantability criteria shall be utilized in this effort primarily to establish the appropriateness of the Assessment Metholology used and to determine the acceptability of social value schemes utilized. Secondarily, the warrantability criteria should be used within the bounds of personnel expertise to the extent agreed upon by the contractor and NBS to determine the extent to which factually established input/output data have been utilized and the completeness of technical aspects of the Assessment operation.

> Serviceability criteria shall be employed to establish the level of utility of the document as input to HUD decision making. To this end, the review should establish whether the assessment is defensible, whether the actual policy choices and action options available to HUD have been dealt with, whether the assessment has considered the alignment between HUD, other institutions and external factors to determine what extent implementation can occur.

With respect to Task II assigned PPS/GWU, this review was to be carried out as represented by the PPS Performance Evaluative Matrix.

It was also provided that the final evaluation report:

> ...shall detail the specific and general areas of the document requiring revision prior to publication, those areas of the document where the technology assessment methodology is deficient and those viewpoints, impact areas, action options, social environments, and areas of uncertainty not fully considered or identified in the document.

It is evident from the foregoing that questions such as those posed below were useful guiding techniques for the PPS/GWU review of Part IV selected aspects of the ORNL Report:

1) What was the explicitly stated or implicit purpose of each particular section in the scheme of the assessment task-objective assumed by ORNL?

2) What are the critical questions which one would have expected the particular section to address?

3) What methodological concepts and analytical techniques were applied to the examination of these questions?

4) What assumptions and/or qualifications were made in the course of analyzing these questions?

5) What alternative concepts, analytical techniques, and modes of reductionism might have been usefully considered by ORNL?

6) Was the treatment of the questions posed or task proposed in accord with recognized technology assessment methodology? Or was it primarily in form of a general information inquiry? Or was it primarily in form of an implementation strategy for MIUS installations?

7) How were questions and/or tasks handled for which satisfactory data or basic analyses were not available, that is, situations of uncertainty?

8) How does the particular section of the ORNL Report logically relate to and support other sections of the Report so as to provide a systematic and coherent development of the MIUS technology assessment?

9) To what extent does each particular section tend consciously to deal with the assessment task in terms of explicating the analysis and social impact findings so as to be of greatest Serviceability to HUD; other relevant decision makers in the authorization, implementation, and operational phases; and all other participants in some manner affecting or likely to be affected by the implementation of the MIUS technology?

10) What specific rearrangements of format, or revisions in content, or suggestions for re-examination/re-assessment are appropriate for the purpose of rendering the ORNL Report a publishable document?

In addition to utilizing other MIUS studies, assessment methodologies, and the foregoing questions, the following brief exposition of an assessment methodology is given for the purpose of presenting certain concepts which have utility in the evaluation of particular aspects of the ORNL MIUS assessment effort. This assessment approach focuses on relatively well-specified project configurations in contrast to the more or less "open-ended" or "scoping out of possibilities" approach which is characteristic of task-objectives directed to the assessment of configurations specified only in terms of "technological systems" such as MIUS. This PPS/GWU approach is incorporated into the assessment Performance Evaluation Matrix along with additional technology assessment notions for the purpose of providing a graphic illustration of evaluation of an assessment effort against the basic criteria of Interpretability, Warrantability and Serviceability. The principal concepts of this particular technology assessment approach are:

1) A well-specified Project Configuration (technological system with implementing and operational apparatus is to be introduced into:

2) The Relevant Evolving Social Environment defined as the full social context anticipated to interact with the project configuration and including:

   - time period projected
   - relevant geographical area
   - jurisdictional dimensions - authoritative (formal) and private sector
   - participants likely affected by or in some manner affecting the implementation and operations of the project configuration
   - relevant conditioning factors and trends organized in terms of social value-institutional processes (public decision process; process of technological innovation; economic resource allocation; knowledge and skill capabilities and institutional processes; urban and regional development processes; societal behavioral patterns; processes of exercising options pertaining to individual well-being; processes affecting the quality of the natural environment, etc.)

   A critical aspect of the evolving social environment is:

3) The System of Technology Assessment/Implementation Participants which deals explicitly and systematically with all those public and private sector entities, public officials, and private organizations and individuals likely affecting or affected by the assessment/implementation procedures. Such participants having differing perspectives, claims and resources which will be used to develop strategies, based upon their resources and influential social conditions and trends, which can be applied in relevant public/private decisional arenas to achieve outcomes which will satisfy the claims of such participants. Such claims (through appropriate strategies) will be asserted in:

4) The <u>Policy Formulation and Program Implementation PF/PI Process</u> which includes the phases of:

- Perception of the "problem" or "task" or "action" proposed
- Formulation of the "problem context" and problem definition
- Assembly of relevant information
- Invention of alternative means or courses of action
- Assessment/Evaluation/Recommendation of the selected course of action (Project Configuration)
- Formal prescription of law or authorization of new program based on the selected course of action
- Application of new statutory scheme in appropriate decisional contexts and/or implementation of the prescribed program, i.e., course of action
- Appraisal of the Effects of the application of the statutory scheme or of the operation of the program
- Modification of the statutory scheme or of the program based upon continuing monitoring and appraisal

The PF/PI Process provides for the clear identification of the loci of the numerous interactions (decision points) which will likely occur between the System of Participants in the assessment, authorization, implementation, and operation of the proposed project/program, i.e., successive phases of the assessment effort. Each phase of the PF/PI Process will involve a somewhat different pattern of participants and produce a different set of interactions, decisions and follow-on actions. Hence, different effects with respect to type, magnitude, and participants will be produced which the assessment should recognize at each of the foregoing phases. This approach has the advantage of assisting in the specification of:

5) The Relevant Assessment Context which varies with the Project Configuration, the Evolving Social Environment, the System of Participants, the relevant Authorizing and Implementing Public/Private Decisional Entities, and the Phases of the PF/PI Process. In brief, the Relevant Assessment Context is the "zone of interactions" which are anticipated to occur at the intersection of the System of Participants with the Public/Private Decisional Entities at each phase of the PF/PI Process. From each of these interactions, decisions, or follow-on actions, effects will result. The notion of the Relevant Assessment Context is a means by which effects can be comprehensively, explicitly, and systematically identified. Explicitness as to the Relevant Assessment Context contributes to the specificity with which effects can be identified and measured.

The concept of Project Configuration is basic to the assessment approach outlined above. Furthermore, it serves as a highly useful evaluative standard for the ORNL assessment. Project Configuration refers to the means by which a specified public goal is to be achieved in an evolving social environment. This requires that project design must be inclusive of the total implementing resources necessary to place the instrumentality into operation. Unless this inclusive approach is taken, the full range of planned and derivative effects cannot be identified nor can a confident evaluation be made of the probable social benefits and costs and their distribution.

A crucial feature of assessment performance evaluation is its usefulness in determining whether the project configuration is a suitable means for achieving the specified social goal in the evolving social context into which it is to be

introduced. This is one way of stating the notion of Project Alignment Viability. Such "viability" will be achieved to the extent that the project configuration assessed will attain the desired goal in the social environment projected.

If a project configuration having a major technological component is to be employed to achieve a specified objective (the satisfaction of certain transportation, housing, or energy needs), the inclusive project configuration would then need to specify such elements as the following:

- The precise technological component or system to be employed, its readiness or future availability.
- The institutional-processes through which the proposed project must move for purposes of authorization, funding, implementation, operations, etc.
- The formal authority (legal prescriptions, statutory schemes) required for implementation and operations, and the authoritative decisional entities involved in the ongoing prescribing, invoking, applying, and appraisal functions.
- The financing/funding arrangements and the other resource requirements such as informational needs, professional skills, etc., for implementation and operations, including proposed allocations of responsibilities and distribution of attendant costs.
- Special institutional-processes designed for utilization in the implementation and operational stages having the primary purpose of soliciting viewpoints of those community participants who will be or may be affected by the proposed action (formal hearings, arrangements for review of environmental impact statements by interested parties, etc.).
- The management/administrative arrangements which must be provided in both the public and private sectors for implementation, operation, and continuing appraisal.

- The scheduling of the stages of authorization, implementation, and operations.
- An estimate of the costs of the planned configuration elements including "hardware," costs of the efforts required in personnel, time, professional skills, and other requisite resources throughout the authorizing, implementing, and operational stages. (Costs of condemnation of properties, relocation of residents and businesses, and the provision for new facilities and services incident to such a relocation may constitute a major cost item in many projects.)
- Enumeration of the legal (or other) requirements, constraints, and limiting conditions imposed upon the project design such as Public Health and Welfare standards, safety factor specifications, cost limitations, time for completion constraints, etc.

After precise specification of the project configuration and the relevant future social environment, it can be determined with greater accuracy whether the specified alignment of technology, formal authority, institutional structure, financial arrangements, administrative/management operation, the scheduling of events, and the attendant social costs present an effective, efficient and acceptable means of gaining the social objective sought. The viability test will impose the greatest diligence upon the assessing entity in making its social benefit/cost ratio determination and in sorting out the approximate distribution of such benefits and costs. Failure to test the alignment of the project configuration with socio-political conditions and anticipated results can be a serious impairment of both the reliability and the utility of an assessment effort for the responsible mission agency.

The crucial point to note about the notions of Project Configuration and Project Alignment Viability is that they represent more closely the realities of the social situation than do more generalized assessment approaches. Put otherwise, they go to the question of whether a specified project configuration when introduced into a relatively well defined evolving social environment will produce the desired results for which it is intended. Viability goes to the Goals-Conditions-Means-Results test. This approach is specific in that it undertakes to identify precisely what will occur if a given action is taken with respect to a particular social context. This approach is to be contrasted with an assessment approach which presents a task-objective positing a generic system (technological or otherwise) for assessment, one which is thus inevitably "open ended" as to possibilities since numerous combinations of project configurations are under assessment rather than one or more well-specified actions. The "open ended" approach leads inevitably to the analysis of the various options open for each component of the project configuration as opposed to selecting out a particular option for each component and linking such components into a coherent identifiable project configuration.

The development of this section on a framework of evaluation has served several purposes: 1) emphasized the importance of evaluating proposed public programs or other actions; 2) stressed the need to be precise as to the functions which a particular evaluation/assessment is to serve; 3) restated the task-objective of the MIUS assessment as perceived by ORNL and the explicit methodological approach adopted by ORNL; 4) suggested alternative assessment approaches (including that of posing questions relevant to the assessment task) by which the ORNL MIUS technology assessment might be

legitimately analyzed and evaluated); and 5) presented an Assessment Performance Evaluative Matrix (Assessment Process Operations vs. Basic Criteria of Performance) as a graphic illustration of the evaluative tasks undertaken by PPS/GWU pursuant to Commerce Contract 5-35851. As in the instance of the ORNL Report, Assessment Process Operations can sometimes be replaced with relevant sections of the Report evaluated.

The outcome of this Evaluation is presented in abstract form for purposes of providing a succinct statement of the operational significance for ORNL and HUD of the conclusions of this Evaluation. The Abstract (Part I) is a condensation of Part V (Conclusions and Recommendations) and is directed to:

1) the specific sections of the ORNL Report which, as they presently stand, should be useful to HUD and other affected policy/decison-makers, as measured by the basic criteria of Interpretability, Warrantability, and Serviceability (with emphasis on Serviceability).

2) Three Options suggested to ORNL as guidance for revision of the present ORNL Report for the purpose of assuring its Interpretability, Warrantability, and Serviceability as a published document.

ANTICIPATORY PROJECT ASSESSMENT (APA) PERFORMANCE EVALUATION

(Illustrative)

Program of Policy Studies
in Science and Technology
Geo.Washington University
Louis H. Mayo, Director
June, 1975

ANTICIPATORY ASSESSMENT PROCESS	BASIC CRITERIA OF ACCEPTABILITY		
OPERATIONAL PHASES OF EFFORT	INTERPRETABILITY	WARRANTABILITY	SERVICEABILITY
1. APA TASK-OBJECTIVE (Assigned by the Sponsoring Agency or Posited by the APA Entity)			
2. PROJECT CONFIGURATION (Same as 1. above)			
3. SOCIAL PROBLEM CONTEXT (Prescribed by the Sponsoring Agency or the Specific Decisional Context as Defined by the APA Entity)			
4. PROJECT OF EVOLVING SOCIAL ENVIRONMENT (Projection of Plausible Future Social Environments)			
5. CONDITIONS AND CONSTRAINTS ON APA PERFORMANCE and STRATEGY OF ASSESSMENT EFFORT REDUCTION			
6. TECHNICAL ASSESSMENT APPROACH a. Selection of Concepts, Models, and Analytical Techniques b. Application of a. above to Identification & Measurement of <u>Effects</u> (Probability & Magnitude) c. Specification of Social Justice Concepts/Standards/Instrumentalities to be Applied to Social Impacts of Such Effects)			
7. PERFORMANCE OF ASSESSMENT BY APPLICATION OF FORMAL APA ANALYTICAL MODEL a. Quantification of Models b. Data: Types & Acquisition c. Social Value Parameters d. Decision Criteria e. Formal APA Analytical Model Procedures to Identify & Measure Effects & to Evaluate Social Impacts of Effects			
8. ASSESSMENT OUTCOME a. Social Impact Evaluation - Particular Effects b. Social Significance of Particular Social Impacts c. Social Benefit/Cost Ratio d. Dist. of Social Benefits/Costs			
9. QUALITY CONTROL STANDARDS/PROCEDURES OF ASSESSING ENTITY TO ASSURE SERVICEABLE INPUT TO DECISION PROCESS OF RELEVANT DECISIONAL ENTITY			
10. COMMUNICATION OF ASSESSMENT EFFORT OUTCOME TO RELEV. DECISIONAL ENTITY			

PART II - DOCUMENTATION

1. 5 Policy Sciences (1974), at 239.
2. 4 Policy Sciences, Nos. 3 & 4 (May-August, 1974)
3. Id. at 3.
4. Ibid.
5. 5 Policy Sciences (1974) at 240.
6. Id. at 245.
7. Id. at 251.
8. Id. at 255.
9. Id. at 252-270.
10. Id. at 257.
11. Id. at 261.
12. Id. at 265-266.
13. Id. at 267.
14. Id. at 268.
15. Futures (Sept., 1972) at 232.
16. Id. at 235.
17. Id. at 236.
18. Id. at 237.
19. Id. at 239-240.
20. 3 Policy Analysis Jou., No. 3 (Spring, 1975) at 247.
21. Id. at 248.
22. Id. at 249.
23. Id. at 250.
24. Id. at 251.
25. Ibid.
26. Id. at 252.
27. Ibid.
28. Id. at 253.
29. Id. at 254.

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IV. THE INTERFACE BETWEEN TECHNOLOGY ASSESSMENT AND THE LAW

A. Scientific Method, Adversarial System, and Technology Assessment

Louis H. MAYO

November 1970, pp. 16-32; 78-109

III. Adversarial System

Expressions such as "adversarial system," "adversary process," and "advocacy" tend to convey an image of an argument or a contest. Advocacy is often defined as "pleading for" a person or position.[18] Some undoubtedly equate advocacy with rhetoric or "the art of influencing the thought or conduct of one's hearers."[19] In his article on "Concealed Rhetoric in Scientistic Sociology" Richard M. Weaver states:

> Rhetoric is anciently and properly defined as the art of persuasion. We may deduce from this that it is essentially concerned with producing movement, which may take the form of a change of attitude or the adoption of a course of action, or both.[20]

In this brief statement there is little to suggest that advocacy or the adversarial system is or might be a method of inquiry as well as a technique of influencing a decision outcome.

There is a great deal more to the adversarial system than rhetoric, however. In a recent treatise on the former, William A. Blaser commences his analysis with a discussion of the adjudicatory model of the adversarial system. Clearly, the assumption is entertained that, from the presentation of rival claims prepared independently by the interested parties, the "true" facts will emerge and that the "correct" rule will be applied.[21]

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[18] The American College Dictionary.

[19] Ibid.

[20] Essay in Scientism and Values (Schoeck and Wiggins, Eds., 1960), pp. 83-84. "This means that rhetoric, consciously employed, is never innocent of intention, but always has as its object the exerting of some kind of compulsion." Ibid.

[21] Blaser, Pretrail Discovery and the Adversary System (1968), p. 4.

He makes the following points:

> The adversary system's method of investigating the facts of a case is conditioned by the system's ultimate aim of exploring disputes thoroughly, enabling all parties to present their claims in their own words, and settling the disputes decisively without violence.[22]
>
> The adversary system distinguishes between the roles of advocate and judge because, it is assumed, one inhibits performance of the other.[23]
>
> The adversary system assumes that public respect for the courts is necessary and depends on judicial neutrality.[24]

Additional assumptions relative to the adjudicatory model of the adversarial system pertain more directly to the development of relevant information:

> The adversary system places the burden on the parties and competitive relationship motivates each to find all the law and facts.[25]
>
> The adversary system gives each party the full responsibility and opportunity to reveal defects in the rival's arguments.[26]
>
> By separating the partisan advocate from the judge of the law and facts, the adversary system tries to ensure that the decision-maker suspends judgment until all the arguments and proofs have been presented.[27]

Blaser advances a further proposition concerning cases of first impression for which there is no settled precedent that "the adversaries do not merely urge the court to adopt whatever well-defined but competing legal principles

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[22] Ibid., p. 13.

[23] Ibid., p. 4.

[24] Ibid., p. 5.

[25] Ibid.

[26] Ibid., p. 4.

[27] Ibid.

can apply to the facts most advantageously to themselves, but their arguments and mutual criticisms help the court develop new and more clear principles of law for that class of cases."[28]

The assumptions made about the advantages of the adversarial system as a technique of inquiry are somewhat blunted by actual practices. As Blaser says, "Since the parties in a fight seek victory rather than truth for its own sake, their presentations may confuse rather than help the court."[29] For example, expert testimony is often shaped to partisan ends. Further, "While the trier of facts wishes to know everything that is pertinent, a partisan who discovers harmful information is motivated to conceal it from the adversary and from the court."[30] While the practice of concealment is to some extent considered to be in accord with the "rules of the game" in an adversary decisional arena such as a court or a regulatory agency adjudication where the primary objective of the advocate participant is to prevail, such practice could seriously hamper the assessment process where the objective is to assemble complete information on a given application.[31]

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[28] Ibid., p. 13.

[29] Ibid., p. 6.

[30] Ibid., p. 7.

[31] See generally on the adversarial system, E. Barrett Prettyman, "Some Observations Concerning Appellate Advocacy," 39 Va. L.R. 285 (1953) wherein Judge Prettyman discusses both brief writing and oral argument and quotes John W. Davis on oral argument techniques, at 299, as follows:

> "'The statement of the facts is not merely a part of the argument, it is more often than not the argument itself. . .'
>
> "'Always "go for the jugular vein".' By that is meant that upon oral argument the lawyer should pick the nub of the case and go for it. '. . .(T)he quintessence of the advocate's art'

In an authoritative decisional arena, advocacy has as its objective the presentation of claims or demands that the decision or outcome allocates values, i.e., rights and duties, benefits and costs, in designated ways. But advocacy in the sense of attempting to influence outcomes is also employed as a strategy in assessment forums. While the assessment process culminates in an informational outcome as contrasted with a binding value allocation, it nevertheless involves a decision or determination as to the outcome which distinguishes such processes from a mere "bull session." Advocacy in the assessment forum is directed toward gaining recognition for certain types of effects of a technological application and toward persuading the assessment entity to apply evaluative criteria to such effects (socially desirable or undesirable and the magnitude thereof) so as to reflect the participant's preferences.

> Mr. Davis calls the ability to pick one single point and drive it home as the only worthy topic in the case. If you are superbly courageous, you can concede impossible and even dubious points."

Arthur S. Miller, in "Drawing the Indictment," *Saturday Review*, Aug. 3, 1968, pp. 39-40, summarizes the adversary system thus:

> "The adversary system, in sum, is based on two premises: first, that the lawyers and judges are competent in the matters dealt with, and second, that the system can provide enough of the right type of data to make viable decisions."

Professor Miller believes that both assumptions are incorrect with regard to courts as they are presently constituted. See *infra* p. 81 of this paper.

See also, on the adversarial system, Milton Katz, *The Relevance of International Adjudication*, (1968) chap. 2.

IV. Similarities and Differences

We can probably agree that scientific method is aimed primarily toward enlightenment, i.e., the production of knowledge, while an adversarial system is directed primarily toward power, i.e., the assertion of claims and the influencing of decision outcomes.[32] But the adversarial system clearly includes an enlightenment component. The adversarial system not only attempts to shape the outcome directly (as with mere rhetoric), but is supported to some degree by the organization of relevant information including both factual events and appropriate rules or criteria of decision. For example, when applied in the ultimate political decision arena where the issue involves a technological application, the adversarial system subsumes the assessment function.

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[32] To draw on a social science example rather than a technological application, consider the following observation in the review by David M. Schneider of Rainwater & Yancy, "The Moynihan Report and the Politics of Controversy," Bulletin of the Atomic Scientists, March 1968, pp. 20-21:

> "But the major problem remains, this time fairly and well put by the authors: 'The central issue raised by the Moynihan Report for the government social science relationship is that of the political use of social science findings.' That is, the Moynihan Report is not basically a research report or a technical document; it is a polemic which makes use of social science techniques and findings to convince others. It was designed as a persuasive document because Moynihan felt that the social science data he could bring to bear would have a persuasive effect. '. . .the rhetoric of persuasion is generally considerably simpler than the rhetoric of scholarly or research discourse. The suitable criteria for evaluating a persuasive document are not that all its i's are dotted and all its t's are crossed but that it selects some crucial issues and presents them in such a way as not to belie a fuller and more balanced intellectual discussion of them. It is our view that the Moynihan Report does not violate this standard although we recognize that some other social scientists would disagree.'"

This close interaction between enlightenment and power has prompted some interesting analyses of the differences and similarities between scientific method and legal process including the adversarial system. However, the identification of scientific method with verifiable or potentially verificable empirical relationships, that is, with accurate description of phenomena and the prediction of events under given conditions, has convinced some observers that a sharp distinction should be drawn vis-a-vis legal process: That scientific method represents a dispassionate search for the "truth" whereas adversarial system reflects a passionate "urge-to-win"--to impose a position, to achieve a preferred value or resource distribution.[33] Consider, for example, the informational limitations of advocacy as illustrated in Professor Mason's description of one of Chief Justice Marshall's opinions:

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[33] Raymond M. Wilmotte in "Engineering Truth in Competitive Environments," IEEE Spectrum, May 1970, p. 45, advances the thesis that "the success of decisions in both public affairs and industry depends today on the correct assessment of technical uncertainties" and that in "an atmosphere of adversary confrontation, the efforts to hide them can prove the source of much harm." He states further:

> "The mental attitude of the individual who sees that there is a gap in the truth when uncertainties are not expressed is altogether different from the attitude attending the process of finding the truth by the legal process of adversary confrontation, for that method in effect eliminates the voluntary disclosure of uncertainties. Scientists are inherently unsympathetic with this legal process, at least on technical matters." Ibid., p. 46.

Wilmotte seems to be saying that the adversary process tends to add confusion to factual determinations, particularly where the "uncertainties" as to facts are significant. His references are to the factual/effects phase rather than to the value or social preference phases of the assessment-decision process. He feels that areas of uncertainty can and should be reduced in order to enlighten and clarify rather than to confuse. He asserts that "No scientific or engineering study should be considered complete without an 'uncertainty analysis'. No system or component is really understood by its designer until he has carried out such an analysis." Ibid., p. 47. He finds the "adversary confrontation" designed not to "reach

> By minimizing the complexity of the question he had gratuitously set for himself, the Chief Justice ruled out the technical agglutinative approach. He chose to fuse the ingredients Judge Cardozo singled out as necessary for a persuasive opinion--overtones of sincerity and fire, the mnemonic power of alliteration and anthesis, the terseness and tang of the proverb and the maxim. "Neglect the help of these allies," Cardozo warns, "and it (the opinion) may never win its way." Such qualities make for an opinion at once both 'magisterial' and 'imperative.' Such an opinion 'eschews ornament.' It is meager in illustration and analogy. If it argues, it does so with the downward rush and overwhelming conviction of the syllogism, seldom with tentative gropings toward the inductive apprehension of a truth imperfectly discerned.[34]

Contrast the foregoing technique of persuasion with the following description of the scientific mode of presentation:

> The natural scientists have won an enviable reputation for modesty in this respect: they seldom allow their desire for results to carry them beyond a statement of what is known or seriously probable. This often calls for a great deal of qualification, so that cautious qualification has become the hallmark of the scientific method.[35]

A striking if somewhat crude contrast of adversarial system and the scientific approach is that offered by the late Judge Jerome Frank in his book Courts on Trial (1949):

> Our mode of trials is commonly known as "contentious" or "adversary." It is based on what I would call the "fight"

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a conclusion, but to prove one." He adds, "One can generalize from the example of the ABM that whenever the purpose of a technical presentation is to 'sell' rather than to communicate something, and competition exists, the foundation for a process of adversary confrontation is established." Ibid.

[34] Mason, The Supreme Court: Palladium of Freedom (1962), p. 86.

[35] Weaver, supra, n. 20, p. 91.

> theory, a theory which derives from the origin of trials as substitutes for private out-of-court brawls.[36]
>
> In short, the lawyer aims at victory, at winning in the fight, not at aiding the court to discover the facts. He does not want the trial court to reach a sound educated guess, if it is likely to be contrary to his client's interest. Our present trial method is thus the equivalent of throwing pepper in the eyes of a surgeon when he is performing an operation.[37]

Judge Frank characterizes the "fight theory" of justice as "a sort of legal laissez-faire," that whereas classical economic theory postulated "economic man," the adversary system postulates "litiguous man."[38] Several statements in the Report on Technical Information for Congress also attempt to draw a sharp distinction between scientific and legal-political processes, as for example:

> Scientific truth is established by objective demonstration and confirmed by replication; political truth is established by consensual agreement, usually after an "adversary contest."[39]

John Dewey's specific attention to the process of problem solving as reflected in the adversarial system and its relationship to scientific method is illustrated by the following passages:

> As a matter of fact, men do not begin thinking with premises. They begin with some complicated and confused case, apparently admitting of alternative modes of treatment and solution. Premises only gradually emerge from analysis of the total

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[36]Frank, Courts on Trial (1949), p. 80.

[37]Ibid., p. 85.

[38]Ibid., p. 92.

[39]Technical Information for Congress (1969), supra, n. 15, p. 5.

> situation. The problem is not to draw a conclusion from given premises; that can best be done by a piece of inanimate machinery by fingering a keyboard. The problem is to find statements, of general principle and of particular fact, which are worthy to serve as premises. As a matter of actual fact, we generally begin with some vague anticipation of a conclusion (or at least of alternative conclusions), and then we look around for principles and data which will substantiate it or which will enable us to choose intelligently between rival conclusions. No lawyer ever thought out the case of a client in terms of the syllogism. He begins with a conclusion which he intends to reach, favorable to his client of course, and then analyzes the facts of the situation to find material out of which to construct a favorable statement of facts, to form a minor premise.[40]

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[40] Dewey, "Logical Method and Law," 10 Cornell L.Q. 17, 22-23 (1924); reprinted in Cohen and Cohen, Readings in Jurisprudence and Legal Philosophy (1951), pp. 553-554.

Making a determination and then searching for the "authority" to support the conclusion as is reflected in the story about Chief Justice Marshall: "Judgment for the plaintiff; Mr. Justice Story will furnish the authorities," would seem the antithesis of the scientific method. But the pronouncement of Marshall does not necessarily represent his process of reasoning. Chancellor Kent, in explaining how he arrived at a judicial decision, noted that he first made himself "master of the facts" and then:

> "I saw where justice lay, and the moral sense decided the court half the time. I then sat down to search the authorities . . .I might once in a while be embarrassed by a technical rule, but I almost always found principles suited to my view of the case." [Extracts taken from Jerome Frank, "What Courts Do In Fact," 26 Ill. L.R. 645 (1932), reprinted in Cohen and Cohen, Readings in Jurisprudence and Legal Philosophy (1951), pp. 474-476.]

Dewey's attitude toward the lawyer's approach to information gathering and organization would seem to be shared with Gordon Tullock in The Organization of Inquiry (1966), pp. 58-59:

> "So far, I have discussed science and inquiry as though they were the same thing. In one of the general uses of inquiry, this is true, but in other meanings of this term they are different. Investigations may be started which are not motivated by either curiosity about reality or the desire to make practical use of knowledge of the real world, but by some other motive. A lawyer building up a brief for his client, for example, may be much more intelligent, more learned, and more ingenious in his research methods than most scientists, but his investigation is not scientific because he is not searching for the truth. He looks for an argument, based on factual information to be sure, which he thinks will persuade. In fact, in the Anglo-adversary type of legal proceedings, he is prohibited from expressing his personal opinion on this point to the court."

> I do not for a moment set up this procedure as a model of scientific method; it is too precommitted to the establishment of a particular and partisan conclusion to serve as such a model.[41]

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[41]Ibid. But does the focus on a predisposed, partisan conclusion necessarily preclude characterization of such techniques of data collection and organization as utilized in the famous "Brandeis Brief" in support of the normative standard of "reasonable" in Muller v. Oregon, 208 U.S. 412 (1907), as scientific?

"In the fall of 1907 the owner of the Grand Laundry in Portland, Oregon, Curt Muller, decided to appeal a ruling against him by the Oregon Supreme Court. Some months previously Muller had been convicted by a lower court of having forced a Mrs. Elmer Gotcher, one of his employees, to work longer than the ten hours a day permitted by the Oregon law governing women workers in factories and laundries. He was fined $10 for the offense. The Portland laundry incident might have had little importance, except that since the 1905 ruling by the United States Supreme Court in the case of Lochner v. New York, which struck down a ten-hour limit for men working in bakeries, employers had been encouraged to challenge every law restricting hours of work. The Portland laundry owners, employers of women, wanted a clear test.

"From his study of the Lochner decision of 1905 and others involving the clash between Fourteenth Amendment liberty of the property-owner and state legislation designed to protect the weak, Brandeis recognized the kernel of his task: to convince the Supreme Court that the Oregon legislature had acted reasonably in passing its ten-hour statute. The Court had made it clear that it would tolerate protective laws that curbed the employer in the free enjoyment of his property only if such laws were reasonably calculated to promote the social good. The words reasonable and reasonably ran like a thread through one Court decision after another.

"Brandeis immediately put Josephine Goldmark to work pulling together evidence to prove the reasonableness of a law designed to curb the physical and social evils to women attendant upon excessive hours of toil. This evidence was to be from physicians, health inspectors, social workers, and industrial experts rather than from legalists. Medical libraries were combed for documentation; when this was assembled and edited, Brandeis submitted 101 pages of citations from experts in a dozen countries, all bearing on the physical requirements of women for a decent amount to (sic) rest if they were both to work and to fulfill their functions as mothers. Some of his testimony dated back fifty years, and much of it revealed greater official concern with working women's health in the Old World than in America. Brandeis' brief showed that every reliable nonjuridicial authority in Western Europe and North America knew that excessively long hours of work are harder on women than on men; and further, that because women bear children, the physical well-being of humanity requires that their working hours be limited. One citation after another proved that long hours of work led to

Despite the fact that many efforts have been made to distinguish scientific method and legal process, similarities can also be found. All decisional sub-systems within society and especially those which are closely related to a recognized discipline or profession, are necessarily concerned with particular subject matter, thought processes, and institutionalized or customary decisional procedures. While given professional groups tend to specialize in certain types of subject matter, thought processes, analytical frameworks, and customary modes of reaching outcomes, such elements are not necessarily the exclusive province of such professions. Science is the subject matter of politicians as well as scientists. Inductive, deductive, trend, alternative, and goal-value thinking are engaged in by all professional groups to some degree. Further, all such groups are exposed to some extent to the various institutionalized or customary modes of outcome determination. One should not be surprised,

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breakdowns in women's health and morals--to illness, to alcoholism and to prostitution." [A. L. Todd, Justice on Trial (1964), pp. 57-58.]

"But Brandeis' triumph in Muller v. Oregon consisted of much more than success in arguing a case on the basis of actual conditions of industrial life. One reason the case is considered to be a landmark in constitutional adjudication is that the Supreme Court accepted the brief filed by Brandeis as an entirely appropriate means for buttressing the legal argument in behalf of what would be called today welfare legislation. 'The Muller case is epoch-making,' Felix Frankfurter wrote in 1916, 'not because of its decision, but because of the authoritative recognition by the Supreme Court that the way in which Mr. Brandeis presented the case. . .laid down a new technique for counsel charged with the responsibility of arguing such constitutional questions and an obligation upon courts to insist upon such method of argument before deciding the issue." [Konefsky, The Legacy of Holmes and Brandeis (1956), pp. 88-89.]

therefore, that many thinkers have found a degree of correspondence between scientific method and legal process, including the adversarial system.[42]

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[42] The philosophical movement of "analytical or logical positivism," including its jurisprudential aspects, grew out of the application of the methods used in the natural sciences to the study of social and legal process. See Bodenheimer, Jurisprudence (1962), p. 89.

F. S. Cohen, in "Field Theory and Judicial Logic," 59 Yale L.J. 238 (1950), reprinted in Cohen and Cohen, Readings in Jurisprudence and Legal Philosophy (1951), p. 580, quotes from Einstein and Infeld, The Evolution of Physics (1938), p. 259:

> "A new concept appears in physics, the most important invention since Newton's time: the field. It needed great scientific imagination to realize that it is not the charges nor the particles but the field in the space between the charges and the particles which is essential for the description of physical phenomena."

In the discussion which follows Felix Cohen states:

> "Must we not say that the truth of any assertion is a matter of degree, that from certain angles the sentence may give light and that at other angles it may obscure more light than it gives? The angle or perspective and the context are part of the meaning of any proposition, and therefore a part of whatever it is that is true or false.
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> "The location of words in a context is essential to their meaning and truth. The fallacy of simple location in physical space-time has finally been superseded in physics. We now realize that the Copernican view that the earth moves around the sun and the older Ptolemaic view that the sun moves around the earth can both be true, and that for practical though not aesthetic or religious purposes the Ptolemaic and Copernican astronomics may be used interchangeably. We realize that Euclidean and non-Euclidean geometrics can both be true. What is a straight line in one system may be an ellipse in another system, just as a penny may be round in one perspective, oval in a second, and rectangular in a third.
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> "A prosecuting attorney who assumes that policemen are accurate and impartial observers of traffic speeds will arrive at one estimate of the speed of a defendant charged with reckless driving. The defendant's attorney, if he assumes that his client is an honest man and that policemen on the witness stand generally exaggerate in order to build up an impressive record of convictions, will arrive at another estimate. If each honestly gives his views the court will have the benefit of synoptic vision. Appreciation of the importance of such synoptic vision is a distinguishing mark of liberal civilization. To the anthropologist, the tolerance that is institutionalized in a judicial system geared to hear two sides in every case represents a major step in man's liberation from the tyranny of word-magic. If we do not feel that we have to annihilate those who say things we do not believe or, what is generally more irritating,

Morris Cohen, for example, in his writings strongly supported the "hypothetico-deductive" method, asserting that, like science, law is based upon a relatively few primary principles from which particularized legal rules are derived.[43] The resemblance found by Morris Cohen would certainly be rejected by others who might select a different aspect of legal process to examine or who might start from assumptions or conclusions about legal process which differ radically from those of Cohen. Holmes at times seemed scornful of the application of a formal logical approach to legal process

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say things we do believe but say them in strange ways or in unfamiliar accents, we are able to conserve our energy for more useful purposes. Energy so conserved may produce science, art, baseball, and various other substitutes for indiscriminate individualistic slaughter.

"The ancient wisdom of our common law recognized that men are bound to differ in their views of fact and law, not because some are honest and others dishonest, but because each of us operates in a value-charged field which gives shape and color to whatever we see. The proposition that no man should be a judge of his own cause embodies the ancient wisdom that only a many perspectived view of the world can relieve us of the endless anarchy of one-eyed vision." Ibid., pp. 583-584.

43 See M.R. Cohen, "Law and Scientific Method," in Law and the Social Order (1933), pp. 192-197; reprinted in Cohen and Cohen, Readings in Jurisprudence and Legal Philosophy (1951). Citations are to pages in Cohen and Cohen. Representative comments include:

"The method of beginning with hypotheses and deducing conclusions, and then comparing these conclusions with the factual world, seems to be still the essence of sound scientific method." p. 563.

"A deductive system that enables us to derive many legal rules from a few principles makes the law more certain, so that people can better know their rights." p. 564.

"A suggestive parallel can be drawn between the functions of the law and of natural science. Both facilitate transactions by increasing our reliance on the future." p. 542.

"(S)cientific jurisprudence endeavors to analyze all laws as combinations of a few recurrent simple elements." p. 549.

as when he stated that "The life of the law has not been logic: it has been experience."[44] While this assertion would seem sharply at odds with Cohen's, Holmes might be said to have moved very close to the scientific spirit of inquiry by emphasizing the empirical approach and the predictive function: "The prophecies of what the court will do in fact, and nothing more pretentious, are what I mean by the law."[45] Clearly, "science," "legal process," or even "science of law" can be defined, interpreted, and analyzed in a multiplicity of ways, and whether similarities or differences are found depends largely upon the aspect of the concept or process examined.[46]

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[44]Holmes, The Common Law (1881); reprinted in Cohen and Cohen, Readings in Jurisprudence and Legal Philosophy (1951), p. 530.

[45]Holmes, The Path of the Law from Collected Legal Papers (1920); reprinted in Cohen and Cohen, Readings in Jurisprudence and Legal Philosophy (1951), pp. 416-417.

[46]See the interesting introduction to the article by Barbara J. Shapiro, "Law and Science in Seventeenth-Century England," 21 Stan. L. R. 727 (1969):

> "It is a remarkable trick of the English language, and of the historical development of legal thought, that the phrase 'law and science' stands in such sharp contradistinction to the phrase 'legal science.' Nineteenth and early 20th-century lawyers, seeking to carve out an intellectually legitimate and autonomous discipline of law, used the term legal science not to suggest that the law was part of modern scientific culture, but precisely the opposite. They meant that law was a science just as chemistry was a science, and was thus entitled to independent existence. This reasoning rested on an obsolete definition of a science as any systematically organized body of knowledge and on a failure to acknowledge that what made chemistry or physics a science was not its autonomously organized knowledge but the fact that it shared with other sciences a particular method of investigation and a particular mode of stating results.

And consider the statement of Frederick K. Beutel in Experimental Juris-

Many observers who have given careful attention to the interacting roles of scientific method and the adversarial system in the making of socio-political decisions usually attempt to assign different tasks to these

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prudence (1957), pp. 18-19, on the "Essence of Experimental Jurisprudence":

> "A science of law based on a rigorous application of the scientific method should be devoted to the study of the phenomenon of law-making, the effect of law upon society and the efficiency of laws in accomplishing the purposes for which they came into existence. It is immaterial whether or not all of political science, part of each of sociology, economics, philosophy and many of the other social sciences are included within its ken. The line between the 'sciences,' like the definition of law, is little more than a quibble which can be left to the pundits, bureaucrats and administrators; to the scientist, the nature of its subject matter, the methods which it uses and the results which it achieves, rather than its definition, are fundamental."

Suggestions that an approach to problem solving which involves

- Specification of goals,
- Description of contextual conditions and influential trends,
- Invention of alternative courses of action to achieve such goals,
- Appraisal of the outcomes and consequences of alternative courses of action, and
- Cost-benefit evaluations of the consequences of such outcomes in terms of specified goal-objectives,

is a "scientific approach," seems to push the scientific label a bit too far. This is certainly a rational approach to problem analysis if we consider rational to be the application of relevant facts and analyses to specific standards of judgment or consider rational problem-solving to be the selection of satisfactory means to achieve specific objectives. But the types of thinking represented by the components of this decisional model certainly existed long before the Western Scientific Tradition got its momentum. There is nothing distinctively scientific in this approach. It represents alternative thinking which has always been reflected in legislative and policy processes. See Mayo & Jones, "Legal-Policy Decision Process: Alternative Thinking and the Predictive Function," 33 Geo.Wash. L.R. 318 (1964). Nevertheless, modern science has contributed to the more effective utilization of this decisional process. Its empirical, inductive procedures have provided more comprehensive data on the real world and have assisted in better defining the gap between what exists and our aspirations. It has improved our techniques of trend thinking and prediction. It has provided improved means of measuring impacts of given policies, projects, practices and applications and has therefore given us a better grasp of how to move from where we are to where we want to be. The approach to problem analysis noted above, however, obviously involves both "factual" and "evaluative" components so interrelated as to provide a systematic or rational model for social problem solving. Such intellectual tasks as goal

two methods of inquiry or to suggest limits on the applicability of scientific method or of legal process. Judge Lee Loevinger in "Law and Science as Rival Systems" comments as follows:

> The fundamental point that lawyers, as well as scientists, must understand is that both the dialectic method of law and the empiric method of science are merely means of gathering and helping to organize data, and that data may answer some simple specific questions, but they do not provide answers to problems, particularly of the kind with which law and government deal.[47]

> The dialectic method of law is essentially clinical in the sense that it is best adapted to investigation and determination of the "facts" of individual cases and it is not well adapted to the investigation of mass or social problems. Legal procedures tend to break down under the influx of large numbers of cases. . .and simply have no means of coping with large populations or broad social investigations.[48]

> What science has to offer law in this generation, and probably in several succeeding ones, is knowledge of how to gather, analyze, and test data. . .[49]

Loevinger offers as a summary statement:

> The difference in the legal and scientific modes of securing data is, as has often been observed, at least partially a

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clarification, model construction of factor-variable interrelationships, and alternative invention, are involved. It is not surprising, therefore, that similar approaches have been suggested as means by which both science and scientists can effectively relate to the social-political process. See, e.g., Robert S. Morison, "Science and Social Attitudes," Science, July 11, 1969, pp. 150 and 165; Don K. Price, "Purists and Politicians," Science, January 3, 1969, pp. 25 and 31; and Gordon F. White, "Broader Bases for Choice: The Next Key Move," in H. Jarreted, Perspectives on Conservation: Essays on America's Natural Resources (1958), pp. 206, 216-225.

[47] Lee Loevinger, "Law and Science as Rival Systems," 19 U. of Fla. L.R. 530, 541-542 (1967).

[48] Ibid.

[49] Ibid., p. 544.

function of the different tasks performed by law and science. While science seeks to analyze and predict phenomena, law seeks to classify and control conduct. In the most simple and elementary terms it may be said that the function of science is descriptive and law is prescriptive. The essential legal function of prescribing norms is not and cannot be scientific in any sense which the contemporary scientific community would recognize as scientific.[50]

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50 Ibid., p. 535. A professor of rhetoric puts the matter simply: "The difference is that science is a partial universe of discourse, which is concerned only with facts and the relationships among them. Rhetoric is concerned with a wider realm, since it must include both the scientific occurrence and the axiological ordering of these facts. For the rhetorician the tendency of the statement is the primary thing, because it indicates his position or point of view in his universe of discourse. Rhetorical presentation always carries perspective. The scientific inquirer, on the other hand, is merely noting things as they exist in empirical conjunction. He is not passing judgment on them because his presentment, as long as it remains scientific, is not supposed to be anything more than classificatory." Weaver, supra, n. 20, p. 85.

Distinctions between "law" and "science" become somewhat less clear when one shifts from the physical sciences to the behavioral sciences. Consider the following extract from Gordon & Temerlin, "Forensic Psychology: The Judge and the Jury," 52 Judicature, No. 8, March 1969, p. 333:

> "Psychology and the Law often stand juxtaposed. The Law is basically rational and deductive; Psychology is basically experimental and inductive. The Law assumes a volunteeristic source of man's actions and couches its concepts in such absolute terms as guilty or innocent, defendant or plaintiff, sane or insane. Psychology assumes a deterministic basis for man's actions and shrouds its concepts in relativistic and probabilistic terms. The Law, for the most part, seeks answers in legal theory and precedent; Psychology seeks to solve its problems by future research. Yet, one overriding commonality emerges. Both Psychology and the Law are concerned with human behavior: one to study it and aid in its actualization, the other to codify rules for the protection of men and to guide men's behavior toward one another."

For an interesting comparative professional analysis see June L. Tapp, "Psychology and the Law: The Dilemma," American Bar Foundation, 1969, No. 2, Reprinted from Psychology Today, February 1969.

IX. Applicability of Adversarial System to Technology Assessment

As a general proposition it can be stated that any methodology, procedure or technique which increases the adequacy of the identification of effects (scope, intensity, and persistence) of a technological application and which clarifies the social norms against which the desirability or undesirability of such effects can be measured has a legitimate function in the technology assessment process.[129] The utility of any mode of inquiry can therefore be measured by the degree to which it contributes to the execution of the operations encompassed in the concept of Adequacy.

Scientific method is indispensable as one means of producing relevant data; but as a method of inquiry it clearly does not satisfy all of the data requirements for the technology assessment process as defined herein. While the operations of scientific method are essential in establishing cause and effect or probability relationships and in projecting trends, even in contributing to the data required in comparing alternative projects, it has relatively little direct contribution to goal clarification. One must not dismiss, however, the contribution that scientific operations do

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[129] The following statement of Dean Don K. Price in The Scientific Estate (1965) p. 272f would seem of relevance in this connection:

> "Though science has given mankind greater certainty of knowledge, it has gained that certainty by renouncing the concern for purpose that must remain at the heart of politics and administration--in both practice and their theory. . .
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> . . . .
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> The case for the mutual independence of the several disciplines does not depend mainly on the objective validity of the ways by which they acquire and verify knowledge. It depends even more on the political value of maintaining free competition and free mutual criticism in the search for truth."

make in the appraisal of impacts of existing applications. Such data is relevant to goal clarification in the sense that it forces reexamination of posited goals to determine if the means employed are in fact achieving the goals sought or if goals supposedly sought are the objectives actually desired after the implications of such objectives are made explicit by scientific investigation of effects, thus, in effect, contributing to the selection, as well as clarification of goals.[130]

As scientific method reaches its limits of utility, some variation of the adversarial system will usually be introduced. But the Formal Adjudicatory Model of adversarial system is not a wholly satisfactory model of the technology assessment process either, even though it combines both factual determination and normative resolution.[131] Yet there

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[130] Consider this statement of Emmanuel G. Mesthene, supra, n. 1, p. 101:

> "We used to scorn the mind of the military man as rigid, yet he has proved remarkably flexible. In less than twenty years, he has learned that science, which began by giving him new means to his old ends, has ended by giving him a new set of ends. Science has changed his old business from soldiering to a much broader concern with national security affairs.
> . . .To turn to science as a means is to take the first step toward changing one's ends. The question is not whether the ends will change, but when and how, and the manager's principal attention--whether he is managing a business, a government, or an international negotiation--must be on the first signs of change in the ends he thought he was heading for when he began."

[131] See with reference to the general point, Harold L. Korn, "Law, Fact and Science in the Courts," 66 Columbia L.R. 1080 (1966):

"CONCLUSION

> "Adjudication faces an institutional setting for 'fact-determination' that seems on its face at war with the kind of aspirations that science can entertain in pursuit of the truth. Built into the system is an extreme tolerance for low-accuracy results. A mere 'preponderance' of the evidence--probability greater than fifty percent--normally suffices to establish a fact as true for the purpose of the litigation, and latitude exists to

are characteristics of the adversarial system such as the motivation engendered in the participants to present the full data to support a position and to carefully scrutinize the positions of other participants which definitely can contribute to the satisfaction of the various operations set forth in the Adequacy Performance Model suggested. Hence, the objective must be to utilize scientific method, the adversarial system and other modes of inquiry to the greatest degree possible in order to optimize the criteria of adequacy.

That adversarial system in some form will probably be introduced into the assessment process is evident.[132] However, the inevitability of adversarial practices in certain assessment forums is not necessarily conclusive

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sustain jury verdicts that are erroneous in the eyes of the court even under this broadly permissive criterion. Much pertinent data is excluded because of policies that the law deems paramount to ascertainment of the truth in adjudication, or under rules designed to screen uneducated nineteenth century juries from evidence that they might overvalue. The evidence that is admissible is gathered and presented in an adversary setting under the result-oriented aegis of the parties; and the tribunal is supposed to base its decision (apart from matters which may be 'judicially noticed') solely on the evidence so produced by the parties of its own."

"It is an important question to what extent this institutional setting properly imposes limits on the goals that may meaningfully be pursued in seeking improved technical decisionmaking. To some extent the justifications for so structuring the traditional trial process may be unconvincing as applied to scientific and technical issues." (Ibid., p. 1115.)

"However they are viewed, it is clear that inherent limitations of the judicial process require that the major stresses of scientific and technological advance be borne by legislative and administrative innovation." (Ibid., p. 1116.)

[132] A strong impression of the "inevitability" of the assertion of partisan claims in various technology assessment forums is provided by

of the desirability of such practices, at least in the manner in which the adversarial system is sometimes employed by particular participants. With respect to the technology assessment process, adversarial system must be appraised in terms of its utility as a mode of inquiry which contributes to the operations of the Adequacy Performance Model. Professor Arthur S. Miller advances a cogent criticism of the adversary system as it operates in the judicial system:

> That deficiency of "ad hocery"--former Bureau of the Budget Director Charles Schultze's term--may be seen quite clearly in the lawyers' desire to judicialize human affairs. They not only view the adversary system of litigation (which deliberately casts witnesses in partisan roles and expects them to be partial in their testimony) as a proper method of settling disputes, but tend to look on it as the *sine qua non* of any situation. But litigation does not suffice when the problems, in Aristotle's classification, concern *distributive justice* rather than corrective justice. As government moves ever more into a system of planning, the adversary system simply will not cope with the needs.
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> There is, furthermore, nothing in the intellectual equipment of the usual judge to make him knowledgeable about many of the problems now brought before courts and those "quasi-courts," the administrative agencies. The same may be said for the average lawyer. (Administrators, on the other hand, are supposed by definition to be endowed with technical expertise, a notion that has been badly oversold in this country.) As a consequence, judges cannot base wise decisions on the information brought to them by contending litigants. Accordingly in the past they have tended to abdicate decisional responsibility to administrators--just as legislators have.
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> The adversary system, in sum, is based on two premises: first, that the lawyers and judges are competent in the matters dealt

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Wollan, *The Process of Setting Safety Standards in the Courts, Congress, and Administrative Agencies*, Part III-Summary and Conclusions, (Program of Policy Studies Staff Discussion Paper 204, 1968). Conversely, the probability of attaining "rigorous objectivity" in the assessment function is minimized.

> with, and second, that the system can provide enough of the right type of data to make viable decisions. Neither idea is valid.[133]

It is clear that adversarial system is discouraged in certain assessment forums or by particular assessment entities. In other words, adversarial system is not viewed as a positive mode of inquiry for the purposes of certain assessment entities. This seems to be the case with the National Transportation Safety Board. This Board is an unusual type of assessment entity, the Department of Transportation Act specifically stating that in the exercise of its function the Board is charged with a continuing review of the safety situation with respect to all modes of

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[133] Arthur S. Miller, supra, n. 31, p. 40. These criticisms focus on the competency of the advocates and decision-makers to resolve scientific and technological questions. Even in regard to traditional courts Miller, ibid., p. 42, acknowledges that:

> "At the very least they could study the problem of making judges and other legal decision-makers more competent. One way to accomplish this would be for panels of experts to be made available to the judges. This is done in Great Britain, with respect to the Restrictive Practices Court (a court that deals with Britain's counterpart of the antitrust laws); there economists are on the staffs of the judges. Further, judges and administrators dealing with scientific-technological issues should have available personnel who could forecast the impact of projected decisions."

Cf. the statement of Arthur Kantrowitz, supra, n. 126.

More difficult to cope with is the view that people, particularly educated people such as scientists and engineers, should be able to cooperate to their mutual benefit in achieving common goals rather than competing for individual benefit and individual goals.

Perhaps this is a consequence of the affluence of science over the past 30 years. But as Representative Emilio Q. Daddario (D-Conn.) pointed out in "Congress faces Space Policy," Bulletin of the Atomic Scientists, May 1967, p. 11, at 15, in reference to DOD and NASA cooperation in space ". . .if the budget squeeze became tight enough, some individuals normally willing to recognize complementary spheres might become more partisan."

transportation.[134] The Act further states that the Board, in the exercise of its functions, powers, and duties, shall be ". . .independent of the Secretary and other offices and officers of the Department." Section 5(b) of the Act prescribes that the Board shall have responsibility for determining cause or probable cause and reporting the facts, conditions, and circumstances of accidents investigated under authority transferred to the Secretary of Transportation.[135] Reports and recommendations of the Board, as well as special studies, must be made public. The Board is concerned with obtaining the fullest possible information. It is not concerned with authoritative determinations of placing fault or assessing legal liability. Its findings are not admissible in court. In order to obtain the most candid and uninhibited evidence feasible it has discouraged adversarial procedure.[136] Nevertheless, the Board does attempt to establish probable

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[134]Public Law 89-670, 89th Cong., H.R. 15963, October 15, 1966, 80 Stat. 931, An Act to Establish a Department of Transportation, and for other purposes. See Section 5: National Transportation Safety Board. See also Annual Report to Congress, 1967, of the National Transportation Safety Board.

[135]The Board is authorized, for example, to:

"Make recommendations to the Secretary concerning rules, regulations, and procedures for the conduct of accident investigations.

"Initiate on its own motion, or conduct rail, highway, or pipeline accident investigations as the Board deems necessary or appropriate.

"Conduct special studies on matters pertaining to safety in transportation and the prevention of accidents.

"Make recommendations to the Secretary which will, in its opinion, tend to prevent transportation accidents and promote transportation safety."

See Annual Report to Congress, 1967 of the National Transportation Safety Board, p. 2.

[136]This is the impression gained by the writer in discussing investigatory procedures with persons cognizant of the Board's operations. See

cause and this finding is obviously related to fault and liability. Here the accident has occurred. Liability for certain parties and remedies for others potentially exists. The Board's recommendations have been generally accepted; thus, its assessments effectively control official decisions. Various participants, therefore, have a stake in its findings or may think they do. This encourages a self interest, partisan approach which may inhibit full disclosure of facts. But in such circumstances, why should it be expected that the adversarial system would not creep into the factual investigations by the Board? One might further ask: Why shouldn't such procedures be accommodated to some degree at least?

Another assessment context in which an attempt has been made to de-emphasize adversarial procedures is discussed by Professor Harold P. Green in his article: "Safety Determinations in Nuclear Power Licensing: A Critical View."[137] In the author's view the public or affected segments of

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Charles Yarborough in the "Crash Inquiry Innovation," Wash. Evening Star, October 28, 1969, A9, col. 6, wherein it is stated that in the investigation of the Indianapolis mid-air collision tragedy "the NTSB will not only sit as a full membership but that another procedural precedent will be departed from: Witnesses, heretofore subject to questioning by batteries of technical experts, will be interrogated only by Board Members."

[137] Harold P. Green, "Safety Determinations in Nuclear Power Licensing: A Critical View," 43 Notre Dame Lawyer 633 (1968) (Reprint No. 1, Program of Policy Studies in Science and Technology, George Washington University.)

Perhaps some scientists and engineers would find the following extract from Felix S. Cohen, op. cit. supra, n. 42, congenial to their temperament. In addressing the topic of The Paradoxes of Judicial Logic, he asks: Are Lawyers Liars? and states in part:

> "How the edifice of justice can be supported by the efforts of liars at the bar and ex-liars on the bench is one of the paradoxes of legal logic which the man in the street has never solved. The bitter sketch of 'Two Lawyers' by Daumier still expresses the accepted public view of the legal profession. So, too, does the oft-told

the public do not have an adequate opportunity to review the considerations that go into the licensing process nor to contest the determinations made.[138] One of his more pungent statements for our present analysis relates to the Atomic Safety and Licensing Boards of three members, two of whom must be technically qualified members of "recognized caliber and stature in the nuclear field":[139]

> Clearly, therefore, the boards do not base their determinations solely upon the evidence within the four corners of the record. The evidence is weighed and assessed in terms of the knowledge, experience, and biases of the expert members of the board. Moreover, the hearing procedures themselves have been significantly de-judicialized on the theory that "trial-type" proceedings are not appropriate for the development of scientific and technical information concerning safety and also to accommodate the procedures to the temperaments of the scientists and engineers who testify and sit on the boards.[140]

A major implication of the foregoing is that concerted efforts have been made to limit adversarial proceedings in nuclear power licensing, no doubt with the best of intentions since this process is viewed by nuclear specialists and enthusiasts as essentially a scientific-technical matter. The Price-Anderson Act of 1957 provided that a mandatory hearing be held on every application for a license for a nuclear power reactor,[141]

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story of Satan's refusal to mend the party wall between Heaven and Hell when it was his turn to do so, of St. Peter's fruitless protests and threats to bring suit, and of Satan's crushing comeback: 'Where do you think you will find a lawyer?'"

[138] Green, supra, n. 107, pp. 652-653.   [139] Ibid., p. 643.

[140] Ibid. Social scientists are apparently more willing to accept the analogy of a trial to critical reviews of their efforts. See, for example, Carl Stover, "Industry, Technology, and Metropolitan problems," 27 Pub. Adm. Rev. 112, 114 (1967).

[141] Green, supra, n. 107, p. 639.

thereby amending the 1954 Act which required only that a hearing be granted at the request "of any person whose interest may be affected," no hearing being required in the absence of such request.[142] The 1957 Amendment was interpreted to require a mandatory hearing at the construction permit stage, the operating license stage, and on any significant amendment to the application at either stage. This approach apparently led to a multitude of hearings, most of which were uncontested.[143] Professor Green states:

> In view of the practice of informal discussion and collaboration between the regulatory staff and the applicant, safety issues were generally resolved before the hearing so that the role of both parties typically was to build a record supporting issuance of the construction permit, license, or amendment. The entire multi-hearing procedure not only invited intervention, but also was in many respects an exercise in time-consuming, expensive futility which was particularly irritating to scientists and engineers, who had little patience for the lawyer's role and the legalistic aspects of these proceedings.[144]

It would appear, therefore, that adversarial proceedings such as reflected in non-essential public hearings can get in the way of adequate as well as efficient assessments. By a 1962 Amendment to the 1954 Act the requirement for a mandatory hearing remained but only at the construction permit stage. "The AEC is, however, required to give thirty days notice of its intent to issue an operating license or an amendment, and it must grant a hearing at the request of any intervenor whose interest may be affected."[145]

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[142] Ibid., p. 637. [143] Ibid., p. 639.

[144] Ibi(, pp. 639-640. [145] Ibid., p. 640.

The effort to restrain non-productive adversarial intervention can be appreciated. This attitude hardly resolves the complex of issues involved, however, Safety or the criterion of "undue hazard" applied in nuclear power licensing is not merely a scientific-technical issue; social risks and benefits are involved in such judgments. A consensus position on such matters, if potentially attainable, would seem desirable, but an imposed consensus, whether it pertains to factual interpretations and predictions or to social objectives, is not only unfair to the affected public but is an inherently dangerous procedure--both technologically and politically.[146] Further, the problem here is not limited simply to determining the best techniques for the promotion of public enlightenment. It also involves the allocation of professional influence over economic and political decision-making. Put another way, the greater the universe of issues that are categorized as scientific-technical, the greater the decision-making power of the scientist and engineer. The consequent jostling for positions of influence as between professional groups or organized societal interests would not seem destined for early demise.

Efforts persist, however, to moderate the public's feelings of dissatisfaction with decisions based on highly conflicting assessments, particularly where serious threats to health are concerned. During the Calvert Cliffs nuclear power hearings, the Washington Post, noting that all such hearings have been controversial, suggested that:

> The least the country can ask, in venturing into a new field of this kind which may vitally affect the environment, is that

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[146] See discussion by Green, ibid., p. 652.

> a competent and disinterested public body take a careful look at all the available facts before the leap is taken. The location of such plants ought to be a major issue before a Council on Environmental Quality.[147]

The obvious abuses of the adversarial system in practice such as concealment of relevant information, introduction of frivolous claims, the distortion of factual data to suit partisan ends, the exaggeration of benefits or of potential dangers, the divisive efforts which prevent consensus on matters where potential and legitimate consensus would serve the public interest, and so forth, should not blind us to the contributions such a system can make in support of more adequate technology assessments.[148] The advantages may be looked at broadly in terms of the pressing need for public participation in major technological decisions. For example, Professor H. L. Nieberg states in his article on "The Tech-Fix and the City":

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[147] Wash. Post Editorial, May 8, 1969.

[148] See John Platt, "How Men Can Shape Their Future" in the Bulletin of the World Future Society, June 1970, p. 9:

> "Several features stand out as requirements for satisfactory group decision-making in the groups and cities and countries of the world ahead. The first is that all social decisions from now on must be participatory. Every individual or sub-group must have as large a share as is practically attainable in the decisions that affect its destiny. . .
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> . . . .
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> Better maps may not only bridge divergent pictures of reality but may even do something toward bridging divergent self-interests. If one route can be shown to be clearly more promising than another in terms of total social costs in reaching a generally agreed-upon goal, then that total social advantage can be partly used to give compensating personal advantages to groups whose interests are damaged by taking that route. Thus, we compensate landowners displaced by a highway, or workers displaced by automation. It is only when the total advantage is uncertain that the disputes rage on. Much wider use of this principle of preassessment and compensation would help many of our needed social changes to go faster and with less disruption."

> The problem is not how to control science and technology. The problem is to recognize which interest groups are exerting preponderant influence and for what purposes--in order that we may seek the time-honored correctives of pluralism--namely visible public accounting and counter-prevailing power. If there is, as Admiral Rickover frequently asserts, an antithesis between blind technology and individual liberty, it is an antithesis between coalitions of narrow group interests able to allocate natural resources toward ends not shared by other large groups. Our theme, therefore, is the need to assimilate the gothic mysteries of science and technology to ordinary political analysis, common-sense political judgment, and plain English. Obviously, the nation cannot deny itself the aid of augmented science and technology in facing the serious problems of the day. But neither can it blindly accept all those claims made in the name of science and technology as inexorable natural forces. Scientific and technical change are far from unstoppable and automatic, but are rather the result of, and responsive to, public policy. The interested public can gain access and predict consequences in this, at least as well as in any, area of policy choice; and all areas are complicated, highly specialized, and jargonized.[149]

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[149] H. L. Nieburg, "The Tech-Fix and the City," in the Quality of Urban Life, Vol. III, Urban Affairs Annual Review, (Sage Publications, 1969) pp. 211, 240.

On the growing intensity of the general public interest in major technological projects, see guest editorial of Eugene B. Skolnikoff of MIT, "Public Challenge of Government Action," in Science, May 2, 1969.

See "Arms and the Scientists: A Long Dialogue Continues," Science, March 28, 1969, p. 1436.

> "The national debate on Sentinel is the first example I know of a military system being a matter of public debate not confined to a small group of experts or advocates of a special cause.--Professor Jack P. Ruina of MIT, a former top Pentagon weapons adviser, at recent Senate ABM hearings.
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> "David E. Lilienthal, first chairman of the Atomic Energy Commission, made this point in a recent CBS public affairs program when he contrasted the ABM debate with conditions prevailing two decades ago when the decision to develop the hydrogen bomb was made. Lilienthal, who opposed development of the H-bomb, commented on the decision and its effect on the arms race. 'Well, it's easy,' said Lilienthal, 'to look back and say you were right, but now we're going through another cycle. . .'
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> . . . .
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> 'Now we're having a public debate about another issue of this kind, and it's casting a lot of light on public policy. The H-bomb should have been discussed that way.'
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> "Certainly there is a new freedom in discussion of weaponry in comparison with the early postwar period, when the military

It must be kept in mind that we are not necessarily concerned with desirable and undesirable social impacts but with which impacts represent positive social values which should prevail in specific assessment contexts. We desire both a pest-free agriculture and a pollution-free environment. How is one to determine what distribution or adjustments are to be made between two social values at a given point in time or during a projected period of time? Certain segments of the public stand to gain benefits and

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> secrecy lid was kept clamped down with wartime tightness. But it is unclear to what extent more open discussion has actually affected key strategic decisions or the process by which they are made."

The adversarial system would seem to be consistent with the implementation of the notion of "social justice" as proposed by Kenneth E. Boulding, "Social Justice in Social Dynamics," in _Social Justice_ (Richard B. Brandt, ed., 1962):

> "I propose to approach the problem of social justice as an economist and social scientist in a manner somewhat different from that which is customary among the philosophers. The philosopher treats the concept of justice as essentially a normative concept. He is concerned with abstract notions of what is right, good, and just. He is concerned with what ought to be, not necessarily with what is. These normative discussions are important and I would not for a moment wish to decry their value. There is, however, another point of view from which the problem of social justice can be examined. This might be called the _positive_ or _operational_ point of view in which social justice --or at least the image of social justice as it exists in the minds of the members of society--is an essential variable in determining the dynamic processes and the evolution of that society." (p. 73.)

> "The perception of divergence between the perceived real value and the ideal value of any important psychological variable--that is, of any variable which is strongly related to utility or general satisfaction--may be labeled _discontent_. In this sense, discontent can be regarded as the prime mover of man to action provided that his image of cause and effect permits him to believe himself capable of such action as to reduce the divergence between the perceived real and the ideal. We may notice a point here, the importance of which will be clearer later. The divergence between the real and the ideal may be reduced by acting so as to manipulate the real. But it may also be reduced by adjusting the ideal. This is the way of renunciation--of wanting what you get, rather than getting what you want. It is traditionally associated with Eastern philosophies, and if adopted it is a powerful deterrent to rapid change." (p. 78.)

other segments of the public stand to be deprived of benefits or to bear additional social-economic costs as a result of these decisions. The adversarial system offers the indispensable means by which the relevant values are clarified and the probable benefits and costs are estimated for the enlightenment of the ultimate decision-maker.

No doubt some observers and participants view the adversarial system as a most serious threat to the achievement of adequate assessment outcomes. But if one begins with that criterion of the Adequacy Model which refers to the comprehensiveness and openness of assessment information, then the <u>adversarial system as a method of inquiry is to be encouraged rather than inhibited</u>. Even the most casual inquiry into the various existing technology assessment systems which have relevance to particular applications will show a tremendous <u>fragmentation</u> of assessment entities and their associated processes of assessment. Improved coordinating mechanisms to serve the purpose of assuring that all such assessment subsystems contribute their inputs to support Total Impact Assessments is perhaps the really crucial need at this particular time. Participation needs to be encouraged rather than hindered. Broadened participation will in turn, no doubt, contribute to additional areas of factual disagreement and to different judgments on the social worth of the application under consideration. This will encourage further resort to adversarial type proceedings. But why not? Advocates for potentially affected participants usually introduce a flow of intelligence respecting the relationship of the parties they represent to the assessment situation which would not

otherwise be available.[150] Not only do we have our long historical judicial tradition to support this proposition but the more contemporary practices of administrative agencies of sending proposed rules to potentially affected parties for comment often taps an extremely useful source of data and appraisals.

Some commentators feel that a well-structured and vigorous adversary system is _the_ crucial technique for technology assessment.[151] This notion

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[150] Consider this statement of Gordon F. White:

"The kind of analysis the nation needs would present estimates of the consequences of each of the politically practicable lines of public action. Thereby, the political process of choice would be sharpened rather than curbed, and governmental intervention seen in perspective with the alternatives.

. . . .

"Agency consolidation, policy formulation, Congressional reorganization, and interagency co-ordination may, indeed, help reduce friction and reconcile operating methods. But they are less basic than an agency or procedure to focus attention upon the choices and effect of public action. Even with such a mechanism we could expect continued conflict, divergence, and pluralism of approach. As Norman Wengert has stated, we should welcome such indecision and friction so far as they reflect searching and experimenting with promising lines of action. We should be dissatisfied only when the choices are not made from the full range that could be marshalled with our potentially available stock of knowledge and skills.

. . . .

"Whether or not the federal government recognizes a greatly refined appraisal process as an aid to decision-making, nonfederal agencies will be needed for that purpose, to double on a small scale for such action in its absence, or to give it competition in its functioning." _Supra_, n. 46, pp. 224-25.

[151] Consider the following extract from Dennis W. Brezina, _The Role of Crusader-Triggered Controversy in Technology Assessment: An Analysis of the Mass Media Response to Silent Spring and Unsafe at Any Speed_, Staff Discussion Paper 203, (Program of Policy Studies in Science and Technology, The George Washington University, April 1968):

"The process of technology assessment in the case of pesticides and auto safety had previously consisted of an unemotional and sporadic debate which centered on highly technical issues of interest primarily to a small circle of experts, and which,

is based on the assumption that new technologies have a momentum expressly and energetically promoted by the proponents of specific applications, that such proposals invariably emphasize, even exaggerate, the benefits to be derived from such applications and minimize the social costs. If this situation is assumed as the general context of technology assessment, then the obvious means for gaining a Total Impact Assessment

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therefore, was largely beyond the understanding of the public. The appearance of the two crusaders and their upsetting books signaled a shift in the tempo and the substance of the previously low-keyed and intermittent debate, for value judgments were injected and simplifications were made in such a way that the issues became meaningful to the public. This popularization phase evoked an emotional response which raised the debate to a controversial pitch. At this time the political implications of the issues became apparent to the public and the Congress and enough interest and pressure was generated to allow Congress to take action. In this way the books served to move the issues from the technical plane to the political arena, where the policy makers could decide on future courses of action before the partially resolved issues gravitated back to the technical public. This movement from expert to crusading critic, to public, to policy maker, and then back to expert, in general describes the pesticide and auto safety controversies.

"In terms of the democratic process, one is persuaded that the public's involvement was to a great extent due to the efforts of Rachael Carson and Ralph Nader. Whether public and congressional interest could have developed without these crusaders is a matter of conjecture. That the technology assessment process did proceed in this fashion in these two cases suggests that other controversies over technological programs might occur in the same fashion in the future. For example, crusader-triggered controversies might enter into the process of assessing the anti-ballistic missile or the supersonic transport, which are two technological programs as yet not explained to the public in any systematic way that points out both their strengths and weaknesses. *In any event it is not clear how public and congressional involvement in the assessment of technology can be assured unless some controversy develops*. If controversy is, therefore, necessary, then *Silent Spring* and *Unsafe at Any Speed* are elements of an emerging tradition of social criticism evolving in response to the scientific-technological revolution. This new form of social criticism has tended to illustrate that public and congressional involvement, even though episodic, can be a viable and influential part of the assessment and application of technology." (Italics added.)

He further suggested a referee or judge to hear arguments and added:

> With opposing briefs, arguments and cross-questioning many facets of the problem, many prejudices of the witnesses would be brought out into the open. The forced opposition is the important point.[157]

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[157] Ibid., pp. 117-118. Apparently, some such procedure was adopted. The N.Y. Times Editorial of July 6, 1969, 8E, col. 1, commented, in connection with Pentagon programs, that "the influence of the Joint Chiefs of Staff. . .has been rising sharply within the Administration" and added:

> "The danger in the current trend. . .is the elimination of checks and balances. The decisions Mr. McNamara made were partly right and partly wrong. But the adversary process he employed, which forced the Joint Chiefs to justify their proposals to civilian experts, was eminently sound. Nowhere else--neither in the Pentagon, nor in the Budget Bureau review, nor in the Congressional hearings, nor in National Security Council and White House studies--does such a thoroughly competent cross-examination occur."

See also Harold Demsetz, "The Technostructure, Forty-six Years Later," reviewing Galbraith, The New Industrial State, 77 Yale L. J. 802, 811-812, for a concise description of the assessment system within the Pentagon between weapons systems and between bidders on a particular weapons system. Because of the requirement for secrecy, an open forum of any real utility would be rather difficult to obtain.

Congress,of course, does on occasion serve as a more or less open assessment forum. The B-70 controversy as well as ABM involved searching examination of the Pentagon's position--whether one agreed with the ultimate outcome of these controversies or not. See Michael Harrington, "The Social-Industrial Complex," Harper's Magazine, November, 1967, p. 55, for a description of the adversary nature of such controversies and of new social programs before Congress, which points up the danger in the present relative lack of capacity of any group which does not stand to make a profit from a favorable outcome to challenge such presentations.

> "Each element in the defense sector--particular industries, branches of the service, 'independent' associations for the Army, Air Corps (sic), Navy, and Marines, and even trade unions--has its own special interest (profit for the companies, prestige and power for the officers, jobs for labor). And each one lobbies for strategies which are determined, not by any objective analysis of the needs of the nation, but by its own stake in the decision. The debate over the B-70 bomber during the Kennedy Administration was a classic case in point. A powerful section of the military-industrial complex, led by the Air Force and aiming to serve purposes of its own, mounted a determined campaign against the Administration in favor of proposals which had been rejected by three Secretaries of Defense under Eisenhower and by Secretary McNamara under Kennedy."

Dr. James R. Killiam, Jr., Chairman of the MIT Corporation and the first White House Science Adviser, proposed in testimony before the Senate Subcommittee on Internal Organization and Disarmament in March 1969, that the U.S. establish a new policy review group. He proposed a task force which could channel public debate on weapons issues by making an "independent, comprehensive study in depth of our weapons technology and of the factors which bear upon the decisions the nation must make." His proposal would seemingly introduce a new, reputable, moderating participant into such controversies which could contain the vehemence and bring a more effective adversarial procedure into being.

> Their special value would be that they would be dependent conclusions reached by a group of competent citizens who were free of organizational loyalties. By virtue of this freedom such a commission could also provide some reassurance to the growing number of citizens who are concerned about the "military-industrial complex" and its alleged influence.[158]

> "Something like this pattern is beginning to emerge within the social-industrial complex. 'Business,' to quote the Wall Street Journal once more, 'is turning into an important force for pushing embattled domestic proposals through Congress.' An executive of the Department of Housing and Urban Development is quoted as saying, 'Each agency has gradually developed a list of firms interested in its field. . .We know how to turn them on. . .' . . .(A)s the experience of the military-industrial complex demonstrates, such procedures lead straight to private alliances between self-interested executives and ambitious bureaucrats. This trend is already quite developed in the cities industry--where, for instance, real-estate men support rent subsidies as a means of attacking public-housing. . ." (p. 57.)

As Lynton Caldwell put it, supra, n. 99, at 128, "American administration of science and technology is not irresponsible; nevertheless it may be argued that it is not sufficiently responsible."

158 Quoted in Technology Review, May 1969, p. 72.

Dr. Killiam added that "it is important for the policy-maker and the public to have the benefit of listening to contending points of view on complex technical and strategic proposals such as Sentinel."[159]

The need for, and opportunity to employ, adversarial system exists to the extent that scientific method cannot supply the data to satisfy the operational criteria of adequacy of assessment. But the need for information and evaluations through methods of inquiry other than scientific method does not necessarily mean that adversarial system can be employed or, if permitted, to what extent. Multiple assessment entities and their associated forums exist which differ in objectives, degree of specific official authority, composition of membership, character and scope of subject matter treated, capability to assemble and analyze data relevant to its objectives, statutory or customary decisional processes, and reputation, including respect status, among participants. These factors plus the general disposition of the assessment entity will determine the extent to which the adversary system may be applicable. Some assessment entities will or purport to be non-partisan seekers after the "truth" and stress unbiased, inclusive claims. At the other extreme, adversarial proceedings will not only be expected by the assessing entity but be required as in courts or in regulatory agency and Congressional hearings. The assessing entity may, through time, indicate clearly what types of information and techniques of presentation it tends to rely upon.[160]

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[159] Ibid.

[160] Various types of communications links between information sources and the Congress are noted in Technical Information for Congress (1969), p. 510.

The following tentative hypothesis is offered for the purpose of providing a summary statement of the theme developed herein and for the further purpose of provoking continued critical appraisals of the role of adversarial proceedings in the technology assessment process:

- The greater the uncertainty as to relevant data and effects of technological applications,
- The greater the divergence of preferred social values among the participants,
- The greater the perceived stakes in the authoritative decision to be based, at least in part, on the assessment outcome,
- The greater the probable influence of the assessment on the ultimate authoritative decision,
- The greater the acceptability to the assessment entity of adversarial proceedings,

\# The more likely are the participants to resort to adversarial techniques of data development and outcome persuasion.[161]

The contribution of adversarial system to an assessment will, of course, be measured by the extent to which it satisfies the criteria of adequacy.

There is a very obvious and substantial reason why adversarial techniques will be imposed upon assessment processes such as the National Transportation Safety Board hearings and the Atomic Energy Commission licensing procedure. Such procedures necessarily tend to become adversarial because real interests and values are at stake. While this will depend upon a number of factors,

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[161] While the variables noted may tend to be the more influential regarding the likely resort to adversarial techniques, a wide range of factors which may exist in numerous combinations would be relevant to the testing of the hypothesis. See Program of Policy Studies in Science and Technology, Chart: Process of Technology Assessment/Application, December 1969.

including the assessment forum and the influence that the assessment outcome is likely to have on the authoritative decision, one may appropriately ask: why shouldn't participants having a stake in the ultimate allocation of benefits and costs employ every legitimate means of protecting and advancing their interests?[162] While "impartial assessment sub-systems" can usefully provide independent (more or less) standards of judgment by which partisan claims can be appraised, it is unlikely that our social values and our assessment-decision procedures can or should preclude partisan participants. Further, as set forth previously, there would seem to be a potential gain from the standpoint of improving the adequacy of the assessment process by such partisan participation. In other words, an adversarial system tailored to the assessment process not only reinforces a fundamental political principle[163]:

162
A recent National Academy of Sciences panel report, "Behavioral Science or Electioneering?" reprinted in part in the Saturday Review, November 1, 1969, p. 65, states:

"If there is to be any substantial increase in social experimentation, the public must have a voice in what is permitted. This is a matter not simply of public acceptance of scientific methods of gaining information, but, more importantly, of public participation in decisions that affect the utilization of scientific knowledge. This is true for such classic social problems as poverty and crime; it could be even more important where the products of science and technology may stimulate fundamental changes in human affairs."

163
The late Judge Learned Hand stated in the Associated Press Case, 52 F. Supp. 362, 372 (1943):

"(N)either exclusively, nor even primarily, are the interests of the newspaper industry conclusive; for that industry serves one of the most vital of all general interests: the dissemination of news from as many different sources and with as many facets and colors as is possible. That interest is closely akin to, if indeed it is not the same as, the interest protected by the First Amendment; it presupposes that right conclusions are more likely to be gathered out of a multitude of tongues than through any kind of authoritarian selection. To many this is, and always will be, folly; but we have staked upon it our all."

but also serves as a valuable mode of inquiry.[164]

Yet it would seem clearly desirable to attempt to identify those areas of agreement or consensus relevant to the assessment, particularly

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[164] This "theme was sounded on April 14 by Dr. Kenneth S. Pitzer, then President of Stanford University, a former research director for the AEC and a recent chairman of the President's Scientific Advisory Committee. Urging a testing delay in central Nevada and Alaska until independent scientists could study the possible effects, Pitzer said:

> 'The problem in this case is not that the risk is completely ignored; rather, that it has been examined primarily in closed circles with the effective judgment rendered by officials committed to the test program. This sort of problem should be considered by an impartial judge and jury. I believe the risk that a damaging earthquake might be triggered deserves a much more substantial public hearing. Then Congressmen, Governors, and other responsible public officials, as well as the interested public, can form their own judgment, balancing this and any other risks against the need for tests or the extra costs of moving to a (safer) location.'"
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> Gladwyn Hill, "About 355 of 'Those Things' Have Exploded in Nevada," N.Y. Times Magazine, July 27, 1969, p. 36.

Consider also the following extract from a talk by Representative Emilio Q. Daddario (D-Conn.) at Washington University in St. Louis on February 12, 1969, quoted in Science, March 15, 1969, p. 1183:

> "Let's take one example--the 200 BEV accelerator proposed for Weston, Illinois.
>
> "You may be, and probably are, much interested in the 'policy' machinations which resulted in a decision to go forward with this highly publicized, highly expensive bit of 'big science.' I am, too. But I must confess I do not know what they were.
>
> "What rationale is behind the priority given to the accelerator? (Not that given to the facility itself.) Who was most responsible? The National Academy of Sciences? The Congress? The Atomic Energy Commission? The National Science Foundation? The Office of Science and Technology and the Federal Council? The President's Science Advisory Committee? Or was it the remnants of the old World War II MIT-Los Alamos axis whose guiding lights are sometimes alleged to have been dominating U.S. science ever since? What logic actually governed the selection of the site? And, in this case, did an 'in-group' make the recommendation; if so, was its real advice followed?
>
> "These are questions on which we have all read much and speculated much. Certainly, they are questions of policy. Just as certainly, very few know the answers, and I sometimes wonder if anyone knows them all.
>
> "But the point here is to suggest that many of the important

the technical aspects, as early in the assessment process as practicable. In other words, it would seem highly desirable that to the extent a potential consensus exists, it should be formulated and stipulated in order to restrict the areas of uncertainty and difference as much as possible. This will prevent those aspects of the assessment which are determinable and can be agreed to from being distorted by subsequent conflicting assertions, interpretations, and partisan claims. Perhaps in some situations the most adequate assessments can be made at an early phase of the development of a new technological application before interests in the application have become consolidated as by investments or by the assignment of program authority. But this also means that relatively little will be known at this stage about the impact of the operations. This is another variation of the eternal dilemma of whether information is to be sought from those who are essentially unbiased and therefore probably only superficially informed or whether advice is to be sought from those who have studied the problem in depth and have in the course of this process in some way become committed or identified with a particular application or interest.[165]

There are, however, difficulties with the foregoing hypothesis that the potential for consensus is greatest at the earliest phases of a proposed technological application. Surely, disputes are to be expected on every conceivable factual and normative issue in the assessment of existing

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details of federally assisted scientific endeavor in this country are decided without being responsible to any policy, formal, or informal. . ."

[165] Cf. the statement of Arthur Kantrowitz, supra, n. 126.

applications where stakes are already consolidated. But even in the case of developed technologies where an assessment is simply for a new project resembling many existing applications, the early phases of the assessment process may present the best opportunities for resolution of differences. Put another way, as the assessment process approaches the final assessment forum and the ultimate authoritative decision, the more likely that partisan claims of participants will be vigorously pressed. But again, reservations arise. The procedural closeness to the ultimate arena may not identify the most crucial forum, i.e., that assessment forum which will have the greatest influence on the ultimate allocation of costs and benefits. For example, the hearing on the initial construction permit for a nuclear reactor may be a far more critical assessment point than a subsequent hearing, by request, just prior to the granting of the final permit. Hence, one can expect, within procedural limitations, that the adversarial system will be employed with maximum vigor and expertise in what is perceived to be the critical assessment forum.[166]

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[166]Limitations on adversarial techniques, however, may severely cripple the public's right to participate in decisions which vitally concern it. See for example "Maryland A-Plant: Boon or a Menace?" Wash. Post, Aug. 26, 1970, p. 1, col. 1, wherein it is stated:

> "Dr. Edward P. Radford, professor of environmental medicine at Johns Hopkins University, is among the scores of people who have criticized the events in the decision-making process.
>
> "He notes that in May of 1969, the AEC began hearings on Baltimore Gas and Electric's application for a construction permit.
>
> "Although opponents regarded this as the key hearing in blocking the plant, the AEC pointed out that the law governing such proceedings prohibited presentation of testimony regarding the choice of plant location, thermal effects on marine life in the Bay, power line location and the relationship between the size of the plant and the actual power needs of the area to be served.
>
> "Testimony was therefore limited strictly to matters regarding actual plant construction."

To the extent the above situation does or will pertain, it raises a most difficult and critical question concerning the role and the efficacy of existing or proposed "neutral" or "unbiased" or "non-partisan" assessment entities. If, as the tentatively advanced hypothesis suggests, the most vigorous partisan demands will be made (or attempt to be made) in the most critical or influential assessment forums, what is the implication of this assumption for the role of a supposedly impartial assessment entity? Of course, the answer might differ somewhat with the structure of the assessment system for different technological applications, with the stage of the assessment process as the assessment moves from proposal to recommendation to ultimate authorization, or even with particular operations of the Adequacy Performance Model. But the crux of the matter is that <u>partisan claims will be focused on the more influential assessment forums</u>;[167] and the more influential the assessment outcomes of a given assessment entity on the final authoritative decision, the greater the

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[167] Consider Lynton Caldwell's statement, <u>supra</u>, n. 99, pp. 128-29:

> "The locus of responsibility for this kind of policy guidance is obviously. . .a function of the Congress, the President, and the Supreme Court. But the knowledge required for policy decisions in the new age of science cannot possibly be developed at this level. . .(P)ublic policy making must be sought at those levels in the structure of decision where the knowledge is. . . (T)he technological bias of our social attitudes and administrative programs make it easy for technical judgments to become social decisions without adequate appraisal of the implied consequences."

See also M. Harrington, <u>supra</u>, n. 157.

This is partly compensated for by deliberately structuring institutions around these people to protect them from their own lack of knowledge --although these institutions are by no means sufficiently knowledgable.

> "But even with a President and a Vice-President who are firmly on record as advocates, the program is not automatically guaranteed clear sailing in the executive branch. The Executive Office of the President is not an open door to budget suppliants in NASA and

effort that will be brought to bear to impose partisan demands on the assessment process (forum proceedings) of such entity.[168] In the Congressional hearing (assessment forum) certain possibilities seem apparent. If a given Congressional committee or sub-committee should tend to rely primarily upon the analysis and recommendations of a particular "impartial" assessment entity, then interested participants would surely make every effort to be heard and to influence the assessment outcomes of such entity. At the other extreme, the "impartial" assessment entity might be viewed by the committee or sub-committee as "just another witness," in which case the entity would enter the Congressional assessment forum as a partisan participant, although with a different perspective from the usual interest-oriented witnesses. In the latter situation the adversarial proceeding would focus at the Congressional hearing level rather than in the forum of the "impartial" assessment entity. But it is simply a matter of at what level and to what extent the adversarial system enters the assessment

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> Defense or other agencies who have space plans to push. Of course their requests are heard. But these requests are screened for the President by a variety of institutional safeguards whose very purpose is to protect a President from his own enthusiasms and from the persuasiveness of a particular subordinate official. The Bureau of the Budget is a professional "no" agency; otherwise the limit to federal expenditures would be almost impossible to fix short of disaster.
>
> ". . .The consequence is that it is most difficult to establish new forward commitments in the executive branch. The desire is there, perhaps, but the realities of total national needs are a strong constraint." Rep. Daddario, supra, n. 133, p. 16.

Of course, Congress cannot rely on such a "no" agency since it doesn't have one--except itself.

168 The pressures that can be brought to bear upon the ultimate assessment/decision entity is well illustrated in the fluoridation controversy. See Wollan, "Controlling the Potential Hazards of Government-Sponsored Technology," 36 Geo. Wash. L.R. 1105, 1125, 1130 (1968) (Reprint No. 2, Program of Policy Studies in Science and Technology, July 1968.)

process. Partisan claims will be made or, at least, heavy pressure will be brought to bear to have them heard. Hence, the "impartial" assessment entity in all probability cannot escape the adversarial procedure.[169] Either its own assessment process will have to provide for adversarial procedures or it will have to enter the Congressional assessment forum as one of multiple participants in an adversarial assessment context. It may, nevertheless, be plausibly maintained that while the conventional partisan inputs to the Congressional assessment forum are indispensable, there is clearly further need for one or more "disinterested, public-interest-oriented" assessment entities which can provide the Congress with a full spectrum of prospective impacts of proposed technological applications. Yet it would seem most unlikely that in our political system such an "unbiased" assessment entity could operate as a

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[169] Without positing a particular model of an assessment arrangement it is not feasible to identify the specific difficulties or issues which would arise with respect to concept, prescribed functions, organization and operations. Assuming the possibility of the establishment of a more highly institutionalized and centralized assessment function than now exists, surely past experience with official entities such as courts and the regulatory agencies would be suggestive in identifying the types of issues which might arise. In this connection such articles as that of A. Everette MacIntyre, "The Status of Regulatory Independence," 29 Fed. Bar Jou. 1 (1969), would be useful. And on the further assumption that the new assessors would have objectives similar to those of Federal Trail Examiners in the technologically oriented regulatory agencies and would be confronted with conceptual and operational questions with which such examiners have had to contend, careful attention to John W. Macy's article, "The APA and the Hearing Examiner: Products of a Viable Political Society," 27 Fed. Bar Jou. 351 (1967) would seem warranted.

And in terms of process and the relationship of scientific or technical "facts" to decisional criteria, the article of Harold L. Korn, "Law, Fact, and Science in the Courts," 66 Col. L.R. 1080 (1966) is highly relevant. This article treats in major subheadings: I. Transmitting Technical Information; II. Applying the Scientific Knowledge to Decision of the Legal Issue; and III. Scientific Knowledge as Law or Fact.

decisive assessment instrumentality in isolation from partisan claims.[170] In any event, the shifting interaction in the assessment process between the inputs of adversarial system on the one hand and the inputs of a supposedly disinterested public interest-oriented assessment entity on the other, is deserving of continuing careful examination.[171]

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[170]Hugh Folk, in a paper entitled The Role of Technology Assessment in Public Policy, pp. 4-5, 9, 10, delivered at the AAAS Meeting on December 29, 1969, addresses this point in the following fashion:

> "No matter how objective an assessment might be, it will become embroiled in political controversy if the matter is important.
>
> . . . .
>
> "It would seem to me wise to accept as a political fact that any assessment of an interesting problem is likely to be embroiled in controversy. Those who wish to engage in such exciting activities should look to their flanks. When they prepare assessments they should employ 'no men,' devil's advocates, and experts on 'the intentions of the enemy.'
>
> ". . .if technology policy is to be forged in the fire of political controversy, then a responsible technological opposition must constitute itself. These counter assessors must separate themselves from the closed, coopted, scientific and technological elite that pretends to be above or beyond politics and ally with those political interests and politicians whose objectives are consonant with survival, prosperity, and liberty as the counter-assessors perceive these goals. They must train themselves in the skills, the arts, and even the wiles of the assessment process."

[171]See discussion of the "notion of 'Independence' of the Assessment Function" in the Statement of Professor Louis H. Mayo, "Some Legal, Jurisdictional, and Operational Implications of a Congressional Technology Assessment Component" before the Subcommittee on Science, Research and Development of the House Committee on Science and Astronautics, December 2, 1969. (Staff Discussion Paper 207, Program of Policy Studies in Science and Technology, December 1969.)

Experience with agencies established to protect or promote the "public interest" rather than a special partisan segment of the public, has been something less than an overwhelming success.

An editorial concerning the resort of citizens to the courts rather than to the regulatory agencies, "Back to Caveat Emptor," N.Y. Times, August 24, 1969, E12, Col. 2, states in part--after referring to a study of the Food and Drug Administration which cautioned that exaggerated faith in the FDA "should be dispelled to the greatest extent possible,"--

> "So it should, and the candor of the study is admirable. But where does it leave the consumer? If he believes the findings--and there is no slightest reason for him to doubt them--he may well

Perhaps those who find the adversarial system in conflict with the notion of "demonstrated truths," with a sensitivity toward precision, and with a dispassionate approach to assessment, look forward to a beautiful future wherein sophisticated techniques of automatic data processing, mathematical modeling, systems analysis, and computer simulation will eliminate the need for adversarial system and obliterate the advocates, particularly the lawyers. But perhaps one shouldn't bet on it.

As the Participant-Computer merges into an operational entity, we shall probably see a somewhat modified form of the adversary system composed

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feel that the nation is fast returning to the rule of <u>caveat emptor</u> that existed before the coming of the regulatory agencies. If he reads Louis M. Kohlmeier's newly published book, 'The Regulators,' he will be sure of it. For the author documents the already familiar thesis that these agencies, set up to protect the public against special interests, tend to forget the public and come to identify themselves with the interests they are supposed to be watching.

"It is understandable, then, that many citizens are concluding that their best resource against damage and deception is the law."

Morton Mintz, in "A Speech Portends Change of Climate," <u>Wash. Post</u>, February 7, 1969, A22, col. 5, writes that:

"The other day, in a talk warning about the location of large nuclear power plants licensed by the Atomic Energy Commission, Senator Edmund Muskie (D-Maine) recognized that 'Government itself develops vested interests which become more concerned with self-perpetuation than with social values. Sometimes economic interests and Government agency interests become so intertwined that the public cannot distinguish between the two.'"

Further, in News and Comment, <u>Science</u>, 29 August, 1969, p. 881, Morton Mintz states:

"It will be recalled that the commissioner, Dr. Herber B. Ley, Jr., said the conflict over the combination anti-biotics was 'between commercial and therapeutic goals.' If he is correct, the Panalba case reaches a great question of our time: In a struggle between public interest and special interest in which the stakes are needless exploitation, injury, and even death to helpless patients, can American institutions function reliably to protect the public?"

of computer-advocates.[172] The model or models employed will differ; the values introduced into the computer as social benefits and costs will differ; thus the outcomes will certainly differ as will the combinations of consequences flowing from such outcomes. While automatic data processing and simulation may lead to the establishment of a greater degree of certainty about some factual situations and relationships, the capability of the computer to vastly broaden the number of alternatives that can be considered with respect to both the effects phase and the normative phase of technology assessment may generate an increasingly greater number of discrepancies, areas of uncertainty, and potential points for disagreement. Advocacy may not yet have reached its hey-day.

Hence, with reference back to de Jouvenel, it seems highly probable that adversarial system has a most promising future in technology assess-

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[172] That new modes of decision-making, designed to reduce uncertainty and clarify options, will be employed is clearly indicated by Daniel Bell, in "The Balance of Knowledge and Power," Technology Review, June 1969, pp. 39-40:

> "In the post-industrial society, there will be new modes of decision-making based on 'intellectual technology.' If technology is defined not just as machines but as a rationalistic attempt at problem solving, using machines, then the new intellectual technology--systems analysis, simulation, decision theory, linear programming, stochastic models--based on the computer will become increasingly important in the analysis of problems and the laying down of alternative solutions."

For a less optimistic view, see Ida R. Hoos, "Automation, Systems Engineering, and Public Administration: Observations and Reflections on the California Experience," 26 Pub. Adm. Rev. 311 (1966).

ment and other phases of the public decision-making process, whether the advocacy is performed by the "ascendant technologist" or the "obsolescent lawyer." [173]

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[173] See Jones, Advocacy in Technology Assessment, Staff Discussion Paper 209, Program of Policy Studies in Science and Technology, November 1970.

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IV. THE INTERFACE BETWEEN TECHNOLOGY ASSESSMENT AND THE LAW

B. Advocacy and Technology Assessment

Ernest M. JONES

November 1970, pp. 60-76

mustered in successful opposition to desirable technological applications. In some instances assessment may inhibit desirable technological innovation. Assessments are particularly subject to the risk that the difficulties of coping with unwanted side effects of technological applications will be magnified, while possibilities that solutions will later be discovered are ignored or minimized. Assessment systems may also be "captured" by a special interest group.[70] Avoidance and minimization of risks such as these is clearly desirable.

8. Criteria of Internal Operations

Another approach to the problem of adequate criteria of assessment focuses upon the internal operations of assessment entities.[71] Operations are conceived as sufficiently discrete to be subsumed under categories and a flow chart is prepared of steps or sequences of categories of operations. By way of illustration a modified version of a flow chart of the technology assessment function of the Congress will be used. See Figure 1 below.[72] While as originally conceived this flow chart made use of

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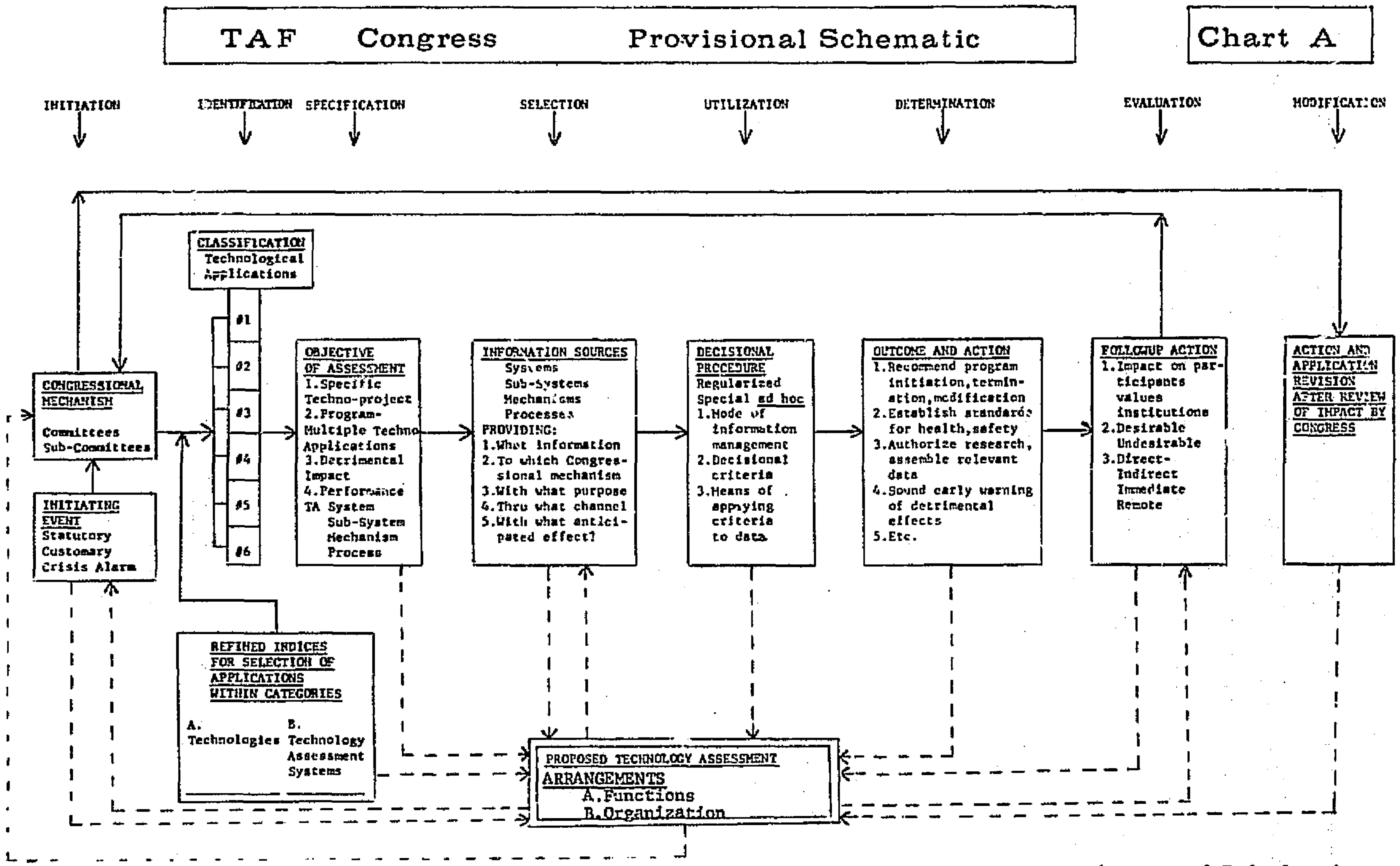
[70] Concerning risks of assessment, see Technology: Processes of Assessment and Choice, supra, note 2, pp. 84-89.

[71] Respecting criteria of internal operations, see Vickers, The Art of Judgment, (1965), pp. 157-169

[72] The flow chart is found in statement of Louis H. Mayo in Hearings before the Subcommittee on Intergovernmental Relations of the Committee on Government Operations, U.S. Senate, on S. Res. 78, 91st Cong., 1st Sess., March 4, 5, 6, April 24, and May 7, 1969, at p. 120. The technology assessment capability of the Congress is also discussed in Technology: Processes of Assessment and Choice, pp. 100-110; Technical Information For Congress; and A Study of Technology Assessment, pp. 9-21, all supra, note 2.

FIGURE 1



Question: How can the proposed Technology Assessment Arrangements improve the performance of each of these phases or operations in the Technology Assessment in terms of time, cost and reliability?

eight categories (initiation, identification, specification, selection, utilization, determination, evaluation, and modification), it is sufficient for present purposes to reduce these to six: problem perception, problem formulation, selection, utilization, determination, and evaluation. Proceeding seriatim criteria will be suggested for the adequacy of each operation.

(a) Problem Perception

The occasion for an assessment may be triggered by a statutory or customary obligation of the Congress, or of one of its committees, or by a social crisis or other stimuli. The important idea of the category is that somehow the Congress comes to perceive that a technology assessment problem exists and merits attention. If the Congressional assessment mechanism adopts a passive stance toward problem perception, waiting for stimuli to come to it (except where a legal or customary duty requires it to search for problems), important problems of assessment (at least until they have reached crisis proportions) and a representative sample of problems of assessment are not likely to be perceived by the Congress. To minimize these risks affirmative scanning or search strategies are required. In other words, the operation of problem perception can be evaluated in terms of its completeness, representativeness and timeliness.

Presumably not all problems of assessment perceived by the Congressional assessment mechanism would be permitted to appear on the Congressional agenda for decision making. Hence some screening of perceived problems is required. The adequacy of the screening operation might be tested by the following criteria: the urgency of the problem; the lack

of assessment efforts respecting the problem by other assessment entities; the existence or lack of existence of another assessment forum; the appropriateness of the Congress as an assessment forum (for example, if it cannot process theproblem it ought not appear on its agenda); the relationship of the problem to other concerns of the Congress; and the nature of the problem (for example, problems of assessing existing technology assessment systems might receive, initially at least, higher agenda priority than problems of assessing past or future technological applications).[73]

(b) Problem Formulation

Since a problem is a disparity between existing and preferred conditions, problem formulation requires a statement of existing conditions (including trends in such conditions), a statement of preferred conditions, a statement of criteria for determining preferred conditions, and an estimate of the gap between existing and preferred conditions.[74]

Criteria of adequacy of statements of existing conditions are: the methodological soundness of fact collecting strategies; the accuracy of

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73 For other formulations of agenda-criteria, see supra, note 2, Technical Information For Congress, p. 474; Technology: Processes of Assessment and Choice, p. 93; A Study of Technology Assessment, p. 5, 9, 10.

74 Mayo urges that adequate formulation of a social problem includes delineation of the social subsystem encompassing the social interactions and effects to be assessed. Since by definition a system (or subsystem) has some capacity for coping with threats to its equilibrium or stability it is not enough merely to trace impacts of outcomes to a social system. The critical issue is: did the impact have sufficient "critical mass" to produce permanent changes in the system, or did the system absorb and neutralize the impact.

the data: the comprehensiveness of the data; and the contextuality (including the degree to which relationships with other institutions, programs, and policy goals are reflected) of the data. It may sometimes be helpful to include a classification of the particular technological application to be assessed.[75]

Criteria for evaluating statements of preferred conditions (goals) may come from numerous sources, including the constitution, statutes, administrative regulations, case-law precedents, and conceptions of policy goals derived from democratic ideology. Since problem formulation ideally requires operational statements of preferred conditions such statements also can be evaluated in terms of possibility of achievement, degree of satisfaction of conceived needs, and, if preferred conditions are also instrumental goals, how ultimate goals will be affected.

Criteria for evaluating criteria for determining preferred conditions would include the criteria set forth above for evaluating statements of preferred conditions. In addition such criteria might also include the extent to which criteria for determining preferred conditions functioned as such (for example, are the criteria sufficiently operational to determine preferred conditions?). Criteria for evaluating estimates of the gap between existing and preferred conditions are the suitability of the methodology and the soundness of its application.

If the problem formulated by the Congressional assessment mechanism refers not to existing or prospective technological applications but to

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[75] See the six-fold classification in statement of Louis H. Mayo, _supra_, note 72, pp. 114-115; and the ten-fold classification system suggested in _Technical Information For Congress_, _supra_, note 2, pp. 480-482.

the adequacy of an existing assessment system, meta-criteria (criteria of criteria) are required. The notion of adequate assessment presented in this paper proposes a set of meta-criteria.

(c) Selection

Selection refers to the operation of choosing "information sources." Perhaps a more descriptive reference is "intelligence sources," since more than mere data or information is required. For example, the political feasibility of a solution of an assessment problem might depend upon the Congress permitting interest groups to contribute inputs of intelligence. Selection involves a definition of the intelligence needed, determinations of where it can be found and how it can be obtained, its dependability, comprehensiveness, contextuality, economy, and probable contribution to the resolution of the problem. Criteria of adequate selection would therefore test the adequacy of the definition of the intelligence needed, of identification of its location and avilability, of methods of obtaining it, and of its characteristics of dependability, comprehensiveness, contextuality, economy, and probable contribution to problem resolution.

(d) Utilization

This operation refers to the decisional procedure used by the assessment mechanism, and, unless they are prescribed, includes choices of the procedures used. Choice of procedures and application of procedures chosen may well be governed by different albeit interdependent criteria. Since choice and application of procedures are instrumental steps for reaching decisional outcomes, criteria governing them should be causally related to the qualities (criteria) sought of decisional outcomes. In other words,

decisions choosing a decisional procedure, and decisions applying chosen procedures might be tested by asking whether the procedure as a whole or some aspect of its application helps or hinders realization of specified qualities of outcomes. Decisions choosing a decisional procedure and applying chosen procedures should also be governed by the nature of the problem formulated (for example, whether assessment of a technological application, or an assessment of a technology assessment system), and by the intelligence sources to be used (it may be preferable, for example, that statistical data from unimpeachable sources be presented in documentary form). The number of participants as intelligence sources may also influence choice and application of a decisional procedure.

(e) Determination

This operation refers to the process of arriving at decisional outcomes and to the outcomes themselves. The process of decision can be evaluated by the criteria of BDM[76] or by the following criteria proposed in Technical Information for Congress:[77] what alternative solutions have been advanced; what are the probable costs and undesirable side effects of each alternative; what are the probable values and useful side effects of each alternative; what are the economic and technical considerations relative to each alternative; are the various alternatives feasible technically, economically, politically; are all apparent alternatives politically or technically unacceptable, thus requiring that additional alternatives

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76 See text p. 38 and note 51, supra.

77 Supra, note 2, p. 475. See also pp. 2-4

should be searched for; what are the implications of each alternative for the short and long term; what contradictions are contained in the information as received; what bias and indications of unreliability prejudice the information; what are the relative weights of the technical conclusions and the information about political values pertaining to the various alternatives after bias and unreliability have been screened out; and what are the relative costs and benefits of adopting the preferred alternative or of not taking action.[78]

Outcomes are the end products of a process of assessment. But these end products may also constitute inputs to intelligence, promotion, prescription, invocation, application, appraisal, or termination functions of the Congress. When this is true criteria applicable to the Congress' performance of these functions would also be appropriate criteria of outcomes of a process of assessment.

(f) Evaluation

Since it refers to post-assessment appraisals of the impact of determination-outcomes, this operation is an appraisal function and should be evaluated by criteria applicable to the Congress' performance of this function.[79]

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[78] For additonal criteria see Downs, supra, note 45, pp. 175-176.

[79] Criteria of appraisal are presented in the text, supra, pp. 30-31.

IV. POTENTIAL CONTRIBUTIONS OF ADVOCACY

Evaluations of advocacy commonly postulate the context of an adjudicatory arena governed by an adversarial decisional model, assume that all advocates are lawyers, and focus upon the strategies of advocates. Consequently, advocacy in non-adjudicatory areans, the role of non-lawyers as advocates, and advocacy as a mode of inquiry supporting intelligence and other decisional functions remain implicit and obscure. Perhaps such failures of evaluation are partly attributable to the commitment of some disciplines (especially "pure" ones), professions and occupations (for example, operations researchers, systems analysts, and management scientists), and schools of thought (in the most extreme form, scientism) to inflexible notions of "truth," "objectivity," and "neutrality." Explicit recognition of advocacy as characteristic of all arenas, of advocacy by non-lawyer participants, and of its role as a mode of inquiry would raise questions about claims to scientific validity, objectivity, and neutrality. And the practice of labeling policy problems as "technical" or "scientific" or "legal" might itself be recognized as a strategy of advocacy aimed at enhancing the power and prestige of technicists, scientists, and legalists.

Some failures in evaluation of advocacy may also reflect a general cultural bias (in particular a bias of academics) in favor of hierarchical and pyramidal, unilateral controls as the preferable modes of coordinating community life, and against bargaining-advocacy as a coordinating mechanism.[80] Finally, since bargaining-advocacy may be "illegal and much (though not all) is extra-legal and is commonly condemned as the product of stupidity,

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[80] See Lindblom, _supra_, note 12, pp. 2, 6-7, 28-29.

partiality, and avarice. . ." its contributions tend to go unnoticed.[81]

How, then, does advocacy fare, as a mode of inquiry as well as strategies of claimants, when evaluated by representative sets of criteria of adequate assessment?

1. Participant Criteria

Openness of participation as a criterion of adequate technology assessment could hardly be achieved without some design for advocacy as a mode of inquiry. Not only does openness look toward affording opportunity for advocacy, but other participant criteria require institutaional arrangements that treat the strategies of claimants, collectively, as part of the intelligence function and as a means of enhancing the quality of assessments. Who is permitted to participate, the degree to which participants are representative of the interests at stake, the timing and form of participation, the contributions expected of participants - these criteria presuppose an assessment design which institutionalizes advocacy as a mode of inquiry. Moreover, quality assessments commonly require intelligence which can be supplied only by advocates, as data about past and future circumstances of participants, the value orientations of participants, and the feasibility (political, economic, and technical) of recommended alternatives for dealing with assessment problems.

While participant criteria presuppose a design for advocacy, other modes of inquiry are not ruled out. Officials and other participants may inform themselves by other means and may present their offerings in other styles

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81 Lindblom, <u>supra</u>, note 12, p. 3

and forms. The essential point of a design for advocacy, however, is that however participants inform themselves and whatever form and style of presentation is used (including claims to speak as "experts" or in the name of scientific validity), all presentations are open to challenge and attack on any relevant ground. From this point of view advocacy is not comparable to other modes of inquiry, because it transcends other modes. It does so not by denying the contributions, but by providing a method for revealing the strength and shortcomings of other modes, including itself as a mode. Moreover, in practice other modes of inquiry, although aimed primarily toward producing knowledge with certain qualities and employing tests such as colleague consensus and inter-subjectivity, are heavily dependent upon advocacy as an internal quality control mechanism. Advocacy thus builds upon other modes of inquiry by providing the conditions under which they may find most fruitful expression.

2. Perspectives Criteria

Apparently officials cannot be assumed to supply the inclusiveness of identification required for adequate technology assessment.[82] Nor is it likely that any discipline, body of experts, professional or

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[82] "The fundamental premise . . . is that bureaucratic officials . . . are significantly -- though not solely -- motivated by their own self-interests." Downs, *supra*, note 45, p. 2. See also *Technology: Processes of Assessment and Choice*, *supra*, note 2, pp. 24-28, 57-62.

occupational group,[83] or governmental entity will always assert common rather than merely special interests in technology assessments. It also seems unlikely that the expectations of participants required for adequate assessments (expectations, that is, of significant influence upon outcomes, of decisional integrity, and of adherence to basic procedual rules) can be created and maintained without employing advocacy as a mode of inquiry.

That claimants-advocates are partisan toward their own interests does not necessarily mean that public interests are inadequately represented in technology assessments. Assessment officials are not confined to the partisan presentation of a single advocate (including the presentation of their own staff) as an intelligence source, but may consider all the intelligence supplied, by whatever means, to their decisional system. And the cumulative impact of narrowly, partisan presentations sharply and precisely in opposition to one another often may spotlight the public

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83 ". . . professional groups, however conscientious, often have unconscious commitments to the technology or technologies with which they are associated and tend, with few exceptions, to make little difference in the basic perspectives from which assessments are currently made." Technology: Processes of Assessment and Choice, p. 25. "The dilemma of intelligence vs. specialization is twofold: specialization is essential to the efficient command of knowledge but antithetical to the penetrating interpretation that bears on high policy; specialization and its concomitant, inter-unit rivalry, frequently block the sharing of accurate information, but if problems of upward communication can be solved, rivalry can result in great gains -- the clarification of clashing alternatives and the presentation of opposing cases. The primary cost of specialization in intelligence is paroachialism -- the production of misleading or irrelevant information, a product of the familiar limitations of the expert. The professionally biased producer of intelligence remains too distant from the intelligence user, too ignorant of policy needs, is forced to compete with other producers for the support and guidance of the user . . . . The gain from constructive rivalry is another matter; it depends on administrative styles and structures that expedite the free flow of rival perspectives and solutions to the responsible executives and their general advisors." Wilensky, supra, note 48, pp. 49-50. See also pages 162-164, especially note 60 on page 164 of Wilensky.

interests at stake. Much depends, also, on expectations of claimants that assessment decisions will be reached in a mechanical and legalistic way, on the one hand, or will represent a conscientious effort to arrive at a formulation of the public interest as seen from the broadest perspectives, on the other hand. When the latter expectations prevail advocates realize that persuasive presentations must be related to and shown to be consistent with policy needs.

3. Situations Criteria

In some settings constitutional or other legal prescriptions require advocacy as a mode of inquiry in technology assessment. If such requirements do not exist, however, since assessment usually involves numerous interactions among participants, provision must be made for such matters as timeliness and sufficiency of notice of proceedings, the scope of matters to be considered, the decisional standards to be applied, the kinds and degrees of participation to be permitted, and the degree of support of the basic decisional functions of the assessment system. These are matters which make advocacy possible and, because of its long experience in confronting them, advocacy is readily adapted to decisions respecting them.

4. Base Values Criteria

As a strategy of claimants and as a mode of inquiry advocacy's contribution is conditioned by the effective means available for its exercise. While this is also true of other modes of inquiry, advocacy has a unique capacity for expanding and economizing the resources of an assessment system. Base values are expanded because participants bring values of all types into assessments. In particular, advocacy may lend the aid of power to assessment outcomes; enlist the wealth of advocates (for)

investigation, preparation, presentation, and other expenses); supply needed standards of rectitude; contribute skill and enlightenment; reduce alienation and increase social cohesion; and promote the health, safety, and comfort of all persons participating in an assessment. To the extent that advocacy augments it also economizes the use of the base values of assessment systems.

That assessment practices and outcomes are influenced by the base values of advocates is not, however, an unmixed blessing. Advocates rarely are equally endowed with such means. In consequence some advocates may be so richly endowed, as compared to others, that practices and outcomes will be skewed against the public interest. The best possible counter-balance for this possibility, however, may be to increase the influence of opposing advocacy.

5. Strategies Criteria

As is true of other modes of inquiry advocacy can emphasize either coercion or persuasion. Relative stress upon persuasion as against coercion, in short, does not appear to be dependent upon modes of inquiry but upon other variables, particularly the base values and perspectives of participants. For example, as political power of advocates decreases greater reliance tends to be placed upon the persuasive use of research findings;[84] and

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[84] "Facts-and-figures men who command technical intelligence obviously are given more discretion where the problems are technical. Less obviously, they also carry more weight when the organization is weak in grass-roots political resources. Among Washington lobbyists, for instance, representatives of small organizations with limited political resources -- humanitarian organizations, specialized trade associations -- accent research in their lobbying strategy, in contrast to large-member organizations, such as farm groups, veterans groups, and labor unions, who incline toward grass-roots compaigns and publicity." Wilensky, <u>supra</u>, note 48, p. 19.

coercive strategies are reduced by creating expectations in participants that only strategies of persuasion are likely to be influential.

Advocacy has a major contribution to make to minimum rationality in assessment. Without it inclusive, balanced outcomes adequately reflecting both common and minority interests appear impossible to achieve. Advocacy also can contribute to and often is essential for the orderly development of each component of policy judgments in technology assessment. Since formulations of problems of assessment requires comparisons of present conditions with criteria of the desirable and with projections of future conditions defined by such criteria, and conceptualization and proposal of the social subsystem to be assessed, advocacy necessarily is involved. This is also true of the prescriptive act of specifying goals.

While not so apparent, formulation of causal or probability links between technological applications and social impacts and between assessment systems and social impacts inevitably requires advocacy. Suitable scientific procedures for this component seldom exist. And even when a suitable science is at hand and requisite controls can be used, discretion (hence advocacy) is not necessarily eliminated. The most basic theories of scientific disciplines are sustained (or undermined) by advocacy.[85] If a consensus

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85 Kuhn, The Structures of Scientific Revolutions (1962). "In the popular view, science is a more disinterested and, therefore, better institution for uncovering truth. But major advances in scientific theory often come from men insisting on opposing models of physical or social nature. They are often polemical; their debate is sometimes carried on in the spirit of armies at war, as Priestley's holding action against Lavoisier's theory of chemical elements, Marx's invective about German idealism, and Weber's insistence on the role of religious ethics in economic life all illustrate. Three characterists of science, however, mark it as different from adversary procedure and limit its use in everyday administrative life as well as in the court. First, although individual scientists may be contentious,

exists among scientists respecting a causal or probability relationship in an assessment, it is supported by advocacy.[86] Such a consensus will rarely exist in any event.[87] Claims of scientific validity often amount to no more than a "dialectic of expertise"[88] Moreover, the objects of an assessment may be advocates with sufficient persuasiveness to co-opt

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they are oriented more toward truth than power. The judge or the official must give some weight to political consequences of decisions; the scientist is ideally oblivious of such considerations. Second, differences in science are settled by colleagues; scientific truths rest ultimately on the consensus of the competent. It is thus too technical for many administrative purposes; the capacity to assess scientific truth is well developed only among those immersed in its traditions and techniques. Finally, because scientific propositions take a long time to establish, science is not an ideal procedure for urgent organizational and judicial decisions. In short, although adversary proceedings do not involve critical experimental tests, they resemble science in their systematic regulation of the clash of views, and they have the additional advantage of sensitivity to political interests, greater availability to non-expert officials and judges, and speed." Wilensky, supra, note 48, p. 153

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"The argument is that the existing machinery of scholarly inquiry and the process of mutual criticism tend to produce, over the course of time, a collective produce, known as knowledge, which is relatively free of special bias. No one, obviously, can say that this process even completely achieves its goal." Frankel, "Being in and Being Out," 17 The Public Interest 44, 58 (Fall, 1969).

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"The higher in the hierarchy one goes the less do problems correspond to the specialized structure of knowledge and the less a decision can be programmed. Only at the lower levels of policy deliberation can the specialized expert tackle a specialized problem with a chance of solving it by the premise methods of science. Further, at any level, the role of the expert is self-changing .-. . . Wilensky, supra, note 48, p. 46.

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"Facts-and-figures men are preoccupied with rational argument and criteria; their technical competence compels opposing parties to be more careful or honest in the use of information to match each other expert for expert, fact for fact." Wilensky, supra,note 48, p.16.

the assessment itself.[89] Nor are assessment officials always models of impartial detachment.[90]

Advocacy may assist in the invention or discovery of alternatives. Since means-ends relations often are highly problematical, and since the discovery of them often is highly creative and subjective, it is desirable that participants advocate a variety of alternatives. Advocacy can contribute to projections of outcomes. In fact all such projections if made to influence policy making constitute advocacy.[91] Forecasts of consequences of policy alternatives usually outrun consensus-based bodies of scientific knowledge. Under such circumstances competing projections by opposing advocates are to be encouraged. The evaluation

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89 ". . . Budget Bureau examines depend for information on the agency they are assigned to investigate; the agency often converts the examiner into an advocate of particular programs by a sensible even flow of information (discounting the risk of disclosing weakness.)" Wilensky, _supra_, note 48, p.18.

90 ". . . there is a kind of inbred tendency, in governmental reports, to support existing policy. We possess an adversary system of government, and an adversary press, and an international ideological struggle is going on . Under these circumstances, reports tend to have a self-defensive function. They accentuate the positive; they give the official what he needs to defend policies that are under attack." Frankel, _supra_, note 86, p. 49.

91 "A forecast that a contemplated action will have this or that consequence is an argument for or against its adoption." de Jouvenel, _The Art of Conjecture_, (1967), p. 147

of projected consequences may also be assisted by advocacy. Since the use of standards of evaluation advocates their suitability for that purpose (including the claims that consequences identified by them as relevant merit evaluation and that consequences not identified by them as relevant do not merit attention), and since competing evaluations expose each other's limitations, advocacy is most useful.

It is true, of course, that when inappropriately channeled advocacy can distort policy judgments. Incompetency in advocates, concealment and exaggeration or minimization of relevant facts, the screening of information through the categories of legal propositions sloughing-off the "irrelevant, incompetent, and immaterial," the presentment of frivilous claims, creation of a "circus atmosphere",[92] exaggeration or minimization of anticipated social costs and benefits, mutual provocations of participants, delayed decisions, and hasty and ill-advised decisions[93] -- each

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[92] "The deficiencies of adversary procedures are obvious. A circus atmosphere may develop as attorneys become preoccupied with press releases rather than legal briefs, with courtroom histronics rather than reasoned argument ("when you can't win a case, jaw it.") Wilensky, supra, note 48, p. 152. Note that Wilensky is referring to advocacy by lawyers at trial court levels of judicial arenas, apparently before juries. Nevertheless, because he entertains a broader conception of advocacy he can recognize its contributions: "But these limitations, not inevitable, are offset by the overriding advantages of partisan advocacy, including the opportunity to test the credibility of witnesses through cross-examination. In or out of court, the adversary process is the best way to assure that assertions are exposed to systematic scrutiny by men with countervailing interests who are motivated to press hard." p. 152.

[93] ". . . bargaining in the wrong place at the wrong time accounts for some of the worse aspects of American government. (1) It explains why conflicting interests often result not in agreement but in the paralysis of public policy, as is illustrated most dramatically by the filibuster. (2) it also gives disproportionate power to the leaders of strategic minorities. (3) It sometimes leads to the substitution of irrational agreement through

of these may cause rationality to suffer. The need, therefore, is for technology assessment entities to adopt procedures that enable advocacy to make its optimum contribution to policy, yet safeguard the procedures of persuasion and decision from disruptive side-effects. The criterion of minimum rationality is not likely to be approximated without the use of advocacy as a mode of inquiry.[94]

Finally, advocacy can promote the criterion that assessment outcomes should assist the ultimate decision maker's performance of basic decisional functions. Thus, it can test for qualities of dependability, comprehensiveness, and contextuality in intelligence functions; and for the rigor with

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log-rolling for agreement upon some common goal. (4) It favors the most highly organized groups." Lindblom, supra, note 12, p. 37. See also Technology: Processes of Assessment and Choice, supra, note 2, pp. 25-27

94 Lindblom's evaluation of advocacy (in particular, bargaining, which is one form of advocacy) is interesting. He argues that advocacy-bargaining is superior in many circumstances to any other alternative (in particular, superior to hierarchial control) for ordering social affairs; that it is the most feasible means for accommodating to the needs of social pluralism; that because the bargaining power of an official depends in large part upon the coincidence of the goals he pursues in bargaining and the public interest (defined as "the achievement of widely shared goals"), and because bargaining power is largely determined through alliances with common interests, the public interest is given operational meaning and promoted; that "the common values of no significant group will be neglected in the final reconciliation of values necessary for policy decisions" ("why the courtroom, the partisan attorney, and the pursuit of victory instead of the study, the scholar, and the pursuit of truth? Because, for all the miscarriages of justice in the courts of law, we do not believe the researcher can give every man his due or bring out every fact and value favorable to him." p. 28); that it aids rationality in organizational contexts by supplying feedback about low level decisions to top level policy makers; that it "motivates men to search exhaustively and ceaselessly for common goals" (". . . bargainers are highly motivated to look and keep on looking, and to become resourceful in finding hidden common goals. And, of course, the search for common values, even where none are found, clarifies goals and reduces pointless conflict stemming from mistaken self-interests." p. 31); and that it reveals wants and frustrations that would pass unnoticed, thereby permitting adjustments of policy in the light of them. See also Fuller's evaluation of advocacy in 1958 Proceedings of the American Association of Law Schools, pp. 188-191.

which scientific method is applied, the contextuality of the method, and the impartiality of findings and recommendations in appraisal functions. It can encourage integrated policy and reliance upon strategies of persuasion rather than coercion in promotion functions. It can promote the promptness with which prescriptive functions are initiated, the contextuality of its explorations, and its conformity to basic goal values. Respecting invocation functions advocacy can help achieve a proper balance between promptness and efficiency in initiation of the process and in maintenance of proper safeguards against irremediable losses, assure contextuality of analysis, promote rationality in provisional characterization, minimize coercion, and demand immediate initiation of follow-on application functions. Respecting application functions advocacy may assist the promptness of initiation, the comprehensiveness and contextuality of exploration, and the choice of decisions conforming to inclusive community policies and capable of effective and economic enforcement. Finally, respecting termination functions advocacy can promote the responsiveness of prescriptions to changes in social processes, help reduce the cost of social change, encourage needed social change, assure comprehensiveness and contextuality in exploration, encourage cancellation in conformity with community policies, and promote effectiveness in amelioration.

6. Outcomes Criteria

Assessments may be intended to produce (1) intelligence to assist resolution of a particular policy problem; (2) appraisals assisting another decisional entity's appraisal of the impact of a particular policy; (3) appraisals of existing assessment systems; and (4) appraisals of total impact assessments.

Since previous discussion indicated how advocacy might contribute to each component of a rational policy judgment,[95] (1), above, will not be discussed. With respect to (2), above, assessments producing appraisals to assist an ultimate decision maker's appraisal of the impact of a particular policy should (2) define what is to be appraised; (b) trace (establish cause and effect or probability relations) and describe the consequences of the policy under evaluation; (c) formulate a conception of relevant consequences sufficiently operational to serve as a guide in tracing and describing effects; (d) posit a set of standards for evaluating the quality of effects traced and described; and (3) report its "findings". Advocacy may contribute to each of these standards.

Since definitions of objects of appraisal involve allocations of scarce base values, influence other tasks of an appraisal, and determine what is not to be appraised, rival definitions of objects of appraisal are foreseeable and should be encouraged. We have seen that establishment of cause and effect or probability relations between particular policies and their consequences seldom can be based on a science of consequences, and even when so based, because consensus is essential for scientific validity, advocacy contributes to the establishment of that consensus and thus to the use of that science. Since conceptions of relevant consequences are partly normative in nature and partly intended as instrumental for tracing and describing (and since the instrumental aspect usually out-runs scientific supports), advocacy

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95 Text, supra, pp. 37-38. The role of advocacy in aiding intelligence functions in general is presented in the text, supra, pp. 21-24.

can, does, and should contribute to them. To posit a set of standards of appraisal is to advocate its appropriateness; alternative sets of standards should be advocated before a set is posited. Finally, reports of "findings" advocate their worth as findings; and, to the extent based on inferences from evidence, advocacy can test the factual support of findings.

Assessments producing appraisals of existing assessment systems, (3), above, should be governed by criteria of appraisal constituting reliable indicia of the quality of the internal operations and external relationships of the object of assessment. Advocacy's contributions to the internal operations of an assessment system will be presented infra.[96] The present analysis, characterizing external relationships and contexts in terms of participants, perspectives, etc. is intended to indicate advocacy's contribution in these respects.

In practice total impact assessments must satisfy criteria for evaluating the outcomes of other assessment systems, for relating outcomes to a conception of total assessment, for a conception of total assessment, and for coordinating the efforts of other assessment systems. Advocacy may help meet these criteria. Its contribution to evaluations of other assessment systems were noted supra.[97] It can aid the formulation of conceptions of total assessment by explicating and critically evaluating their most basic assumptions; and it can assist in relating outcomes of

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96 See text, <u>infra</u>, pp. 74-76.

97 See text, <u>supra</u>, pp. 45-50.

particular assessment entities to conceptions of total assessment by explicating and critically evaluating the relational frameworks employed to achieve syntheses. Finally, advocacy can enhance the quality of efforts to coordinate the assessments of other systems. For example, prescriptions of appropriate spheres of autonomy between assessing systems and systems assessed are more likely to reflect inclusive community perspectives if all perspectives are advocated.

7. Effects Criteria

The reference here is to desirable impacts upon social institutions, the values of the citizenry; the physical and ecological environment; basic decisional functions and structures of legal process; and assessment systems and their participants. Advocacy has contributions for each of these areas.

Advocacy can help preserve and protect social institutions through forecasts or appraisals of adverse impacts upon them, by insisting that their uniqueness requires special criteria of evaluation, by insisting upon an interdisciplinary approach to evaluation of impacts, and by noting their importance for the production of the values to which they tend to be specialized. Moreover, advocacy is essential for the invocation and application of existing prescriptions applicable to social institutions, and it can be indispensable in critically evaluating current debates about roles of social institutions and the contributions of specialists in the study of particular institutions.

Respecting criteria of impact upon the values of the citizenry advocacy can be indispensable for establishing minimum and maximum shaping and

sharing criteria, in the invocation and application of existing prescriptions, and in critically evaluating current debates about desirable levels of shaping and sharing particular values and the contributions of specialists in the study of particular values.

Formulation, invocation, and application of policy respecting impacts of technological applications and assessment outcomes upon physical and ecological environments involve policy functions which outrun the contributions of scientific methods. How much of the fruits of pest-free agriculture are we willing to forego in order to avoid certain effects of DDT? Such questions raise policy issues in the resolution of which advocacy is both inevitable and essential.

Since impacts upon basic decisional functions and structures of legal process are impacts upon the policy making and implementation process, itself, and since it is inevitable and essential to the process, advocacy has a role.

With respect to impacts upon assessment systems and their participants, advocacy and bargaining are essential strategies for creating and maintaining relationships which assure a continuing flow of base values needed by assessment systems. It can help maintain the confidence of all participants in the competency, detachment, impartiality, and open-mindedness in assessing systems. It can help promote conformity by assessment systems being assessed with criteria proposed in this paper. It can promote national coordination and control over assessments. And, it can help systems being assessed to avoid or minimize adverse impacts of their assessments.

8. Internal Operations Criteria[98]

(a) Problem Perception

Advocacy can assist the completeness, representativeness, and timeliness of problem perception. For example, by serving as a supplement to scanning techniques permitting members of the general public to call assessment problems to the attention of the Congress, advocacy might contribute to completeness, representativeness, and timeliness of problem perception. It can also contribute to agenda-making by aiding the formulation of criteria of inclusion and exclusion and the interpretation and application of such criteria.

(b) Problem Formulation

Statements of existing conditions, statements of preferred conditions, criteria for determining preferred conditions, estimates of the gap between existing and preferred conditions - each of these components of problem formulation can be aid by advocacy. Respecting statements of existing conditions it can test the methodological soundness of data collecting strategies used, the accuracy of the data, and the comprehensiveness and contextuality of the data. In statements of preferred conditions it help establish the authoritativeness of criteria, contribute to estimates of feasibility, note discrepancies between statements of preferred and conceived needs, and question whether preferred conditions, if instrumental goals, will achieve ultimate goals. The formulation of criteria

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[98] See text, *supra*, pp. 50- 59.

for determining preferred conditions, since it is a prescriptive act, can be assisted by advocacy, as can be interpretation and application of such criteria. The suitability of the methodology and the soundness of its application in estimating gaps between existing and preferred conditions can be tessted by advocacy. Finally, it can aid in the formulation of meta-criteria for evaluating existing assessment systems.

(c) Selection

Advocacy can help test the adequacy of the definition of intelligence needed, in some instances aid in determining the location, availability, or methods of obtaining that intelligence, and probe its characteristics of dependability, comprehensiveness, contextuality, economy, and probable contribution to problem resolution.

(d) Utilization

Decisions choosing procedures of assessment and decisions applying procedures chosen can be aided by advocacy. If both types of decision are to be evaluated in terms of their impacts upon assessment outcomes advocacy is a useful means for establishing such impacts.

(e) Determination

If the process of arriving at decisional outcomes and the outcomes themselves are to be evaluated by the criteria of BDM or by the set proposed in Technical Information For Congress,[99] or by the criteria applicable

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[99] See text, supra, p. 56

to the performance of basic decisional functions of the Congress, advocacy is a most useful tool for such evaluations.

Advocacy, then, is not only here to stay - its potential is so vast and largely untapped that its future is quite speculative. We must work and hope that it will be used to establish a community in which the dignity of man is honored in deed as well as in word.

N76-15950

IV. THE INTERFACE BETWEEN TECHNOLOGY ASSESSMENT AND THE LAW

C.

Harold P. GREEN

August 1972, pp. 1-11

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When I was asked to give this talk, it was suggested that my topic be "The Law Confronts Expanding Technology." This, I thought, was an inappropriate topic. However true it may be that the law is a static, backwards-looking force in our society, it simply is not true that the law confronts or in any sense resists technological advance. On the contrary, our entire legal system reflects a tolerant, indeed a benevolent, attitude towards technological advance. This is reflected in the patent system rooted in Article I, Section 8, Clause 8 of the Constitution to "promote the progress of science and useful arts," in our tax laws, and in our predisposition for political and economic freedom. Even our common law system has evidenced a disposition to balance pre-existing rights in the status quo against the benefits of technological advance, and generally to sacrifice the former in favor of the latter.

It is important to any discussion of this topic that there be a clear understanding of what "law" is. It is, first of all, a body of rules governing individual activity and relationships among the various actors in society. These rules are found in the vast body of judicial decisions applying the common law. They are also found in statutory enactments and the rules of administrative agencies, as well as in judicial and agency decisions interpreting these statutes and rules. The law is also a process of decision-making as lawyers representing clients with clashing interests seek to have their clients' interests

enhanced, protected, or vindicated before the courts, administrative agencies, and legislative bodies.

When a new technology emerges, it is brought forth into a social environment which includes pre-existing technology and is not necessarily applicable to the new technology or the peculiar social problems which the new technology may bring. For example, when the first automobiles came into existence, there was no law directly applicable to automobiles. There were, however, laws applicable to the use of thoroughfares, to the rights of pedestrians, and to the rights, duties, and liabilities of persons who used horses or horse-drawn vehicles. As the use of the automobile impinged on existing legally protected interests, it became necessary for the courts to consider whether, and the extent to which, existing law was applicable to the automobile. What were the respective rights of users of automobiles and users of horse-drawn vehicles? Were automobiles vehicles within the meaning of statutes written in contemplation of horse-drawn vehicles and bicycles? Were the rules of the road applicable to these new-fangled devices? The courts grappled with these problems on a case-by-case basis as lawyers representing the adversary interests of their clients argued pro and con on these issues, and ultimately, through a process of trial and error, a body of law directly applicable to automobiles began to emerge. Over a period of time the legislatures also began to take cognizance of the automobile, and statutes began to emerge providing for registration of motor vehicles, licensing of operators, inspection, traffic control, liability, etc.

Development of this new body of law directly applicable to auto-

mobiles could have operated as either a deterrent or an incentive to the growth of the automobile technology. We know in retrospect that the incentives, including development of highways, far outweighed the deterrents. Only in recent years, as our legislatures have addressed themselves to problems of safety and pollution, have there been indications that law may be moving in the direction of deterrence.

Let me now attempt a generalized description of the legal system as it confronts expanding technology.

The first response of the legal system to a new technology has characteristically been to deal with the problem entirely as a matter of private law. Legal problems are dealt with within the framework of disputes between private interests: The private parties who are using the technology versus the private parties who may be injured or threatened by the technology. Government, through its judicial processes, acts as the impartial umpire for the resolution of these disputes. As the principles and the wisdom of the past, found in judicial precedent, are applied on a trial-and-error basis to the new problems emerging from the new technology, the process of decision-making in specific litigations results in the emergence of new precedents specifically applicable to the new problems. The emergence of this new body of law creates legal rights and legal duties which become a part of the general legal environment in which the technology develops and is used. The existence of legal rights and duties operates to internalize the social costs of the technology and becomes, to some degree, a deterrent to the advance of the technology. The net result of this process is that our society permits the technology to

cause social disruptions and injury on the theory that the legal system will provide monetary compensation to persons whose legal rights have been violated.

There frequently comes a time, however, when society regards the existence of the disruptions and injuries caused by the technology as unacceptable, and the focus of law-making then shifts from the courts to the legislatures. Whereas the process of law-making by the courts is piecemeal, random, and highly indirect, legislative action is positive, deliberate, and direct. The legislative action may be in the form of new rules redefining the rights and duties of private persons with respect to the technology, or it may be in the form of positive regulation of the technology. It should be recognized, however, that the legislative process usually operates slowly and uncertainly. It is always characterized by inertia and usually also by considerable friction which arises from strenuous efforts by the sponsors of the technology to resist legislative action which will adversely affect their economic interests. As a consequence, the initial legislative action is usually based on political compromise and the enactment, viewed in retrospect, is rarely adequate and remains to be modified in later successive legislative actions as society reaches the conclusion that the disruptions and injuries remain unacceptable.

By and large the system I have described has worked reasonably well over most of the history of Anglo-American law. This is not to say that it has not permitted immense injury, which could have been avoided. Obviously, for example, automobile technology has produced

immense slaughter on our highways which could have been substantially leesened had our law-making institutions come to grips with the problem of automobile safety at an earlier date. On the other hand, there is little question in my mind that, had our current concern with automobile safety arisen in the 1920's or 1930's, our technological progress as measured by the present state of the automobile would have been substantially retarded. When I say, therefore, that the system has worked reasonably well, I am saying that it has provided a framework for enabling technological advance on the assumption that even considerable disruption and injury is an acceptable price to pay for this advance.

The present interest in technology assessment reflects the growing view in our society that such disruption and injury may no longer be acceptable. This view has come into being largely as a consequence of the recognition that the technologies of today and tomorrow may be producing disruptions and injuries which go to the question of survival itself, and that technological advance is occurring at so rapid a rate that intolerable and irreversible levels or injury may be sustained before we are even aware of the fact that the technology involves a capacity to produce injury.

As a lawyer, I see the function of technology assessment as being twofold: first, to provide for legislative action designed to channel technological advance along lines which are regarded as optimal from the standpoint of society's interests; and, second, to encourage and promote legislative action which will deal decisively with the potential disruptions and injuries caused by technology at

a much earlier stage of the growth of the technology than is feasible under the present legal system.

Implementation of the first of these objectives would involve the substitution of governmental decisions for the operation of the market as a determinant of the allocation of resources. Government would presumably discourage less optimum technologies through tax or restrictive regulatory actions and would encourage more optimum technologies through benevolent regulation, tax incentives, or subsidy. Government, as a benevolent big brother, would make a value judgment on what is good for society, and this decision would have the effect of limiting the present right of the public to vote with its dollars in the market place as to what products it wants and what negative consequences it is willing to accept in order to have the benefits it desires. If, for example, technology assessment should result in a legislative decision that cheap but dangerous lawn mowers are *verboten*, lawn mowers would become unavailable to a segment of the public which can afford only cheap lawn mowers and is prepared to assume the risks in order to have the benefits.

Implementation of the second objective would involve a rigorous analysis of the potential benefits, costs, and risks of a technology and the striking of a balance on the basis of which the legislatures would make a judgment as to whether a green light or a red light should be flashed for further development and use of the technology, and if a green light, the manner in which the technology should proceed. Here again a value judgment would be made as to whether benefits outweigh risks and costs. In this connection, it should be

noted that the evaluation of both benefits and risks is based more on predictive judgments than on experience. Benefits, moreover, are usually much more obvious and immediate than risks, which, when considered on a predictive basis, tend to be remote, speculative, and subject to technological fixes (hoped for) that will minimize them. This concept gives me, as a lawyer, some concern. An explicit legislative judgment that benefits outweigh risks could well have the effect of impairing or limiting the right of members of the public to seek legal redress or relief if they regarded the risks as unacceptable to them. For example, a legislative determination that a certain level of aircraft noise is acceptable in the light of the social benefits of aircraft might well have the effect of precluding someone who is in fact injured by the noise from obtaining redress or relief in the courts.

In a large sense, there is really nothing unique or novel in consequences of this kind. Our legislatures have always made decisions of this nature and these consequences have in fact resulted. Still, technology assessment adds a new dimension which troubles me. Obviously no one could seriously question the desirability of our legislatures' having the maximum possible amount of authoritative information on benefits, risks and costs on the basis of which decisions may be made. It is institutionalization of the process of providing such information to the legislatures which troubles me. Most of the recent discussion of technology assessment seems to proceed on the assumption that there exist valid processes through which benefits and risks can be identified and quantified, and alternatives set forth, by specialized elite groups,

and that the legislatures can then make "correct" decisions in the light of value judgments. Indeed, some spokesmen for technology assessment go even further and talk as if the assessment exercise would be a waste of time if the legislatures did not reach the correct judgment indicated in the assessment. My own view is that neither benefits nor risks can be identified, let alone quantified, and that alternatives cannot be articulated, without some large value judgments on the part of the assessors as to what the public would regard as benefits and risks and the importance attached by the public to each item of benefit and risk. Thus, my concern is that the institutionalized technology assessment mechanism will serve to the legislatures a predigested body of information rooted in the value judgments of a small, narrow, elite group and that the result of the assessment process, if taken seriously by the legislatures, will greatly constrain the operation of the democratic processes in the ultimate decision-making exercise.

My concern in this respect is mitigated only by my confidence that technology assessments of this kind, no matter how authoritative the assessment body may be, will not in fact be accepted as conclusive by members of legislative bodies. The assessment will in all liklihood be just another informational input into the legislative process, and legislative enactments will still be based on political compromises reflecting the prejudices, interests, and responses by legislators to the interests of their constituencies.

In short, therefore, I believe technology assessment is a highly useful exercise in maximizing the information available to legislatures,

but I believe that those who regard it as a panacea, or even as an important form of therapy, are taking the concept much too seriously.

A final point I would like to make relates to the role of the law itself in technology assessment. Since legislation resulting from technology assessment will be new law superseding or supplementing existing law, it is important that existing law be considered in the process of assessment. Moreover, since new law always has a disruptive effect on expectations and commitments arrived at under old law, it seems to me to be generally desirable that new legislation should make the least possible change in the law consistent with accomplishing the desired objective. This means, I think, that proposed alternative courses of action set forth in a technology assessment should include an assessment of the first order and secondary order consequences of any suggested changes in the law. In addition, before a technology assessment flashes a green light for advance of a technology, consideration should be given to what legal changes may be necessary in the long run to regulate that technology. For example, one can visualize that some of the emerging biomedical technologies may require regulatory laws which could have a profound effect on traditional individual freedoms. The necessity for such laws is obviously a kth-order consequence of the technology and should be considered in the assessment process. Thus, the technological capability of predetermining the sex or the physical or mental attributes of a baby could well create social conditions necessitating the licensing and regulation of marriage, conception, or birth. Possibilities of this kind should be considered in technology assessments.

In this connection, I throw out a word of caution to those of you who believe that this a "lawyer-ridden world." Institutionalization of technology assessment could well lead to the massive intrusion of legalistic processes into the assessment function. There already is an example of how this could happen. It has been suggested that the National Environmental Policy Act involves something closely akin to technology assessment. NEPA became law on January 1, 1970. There is no indication that anyone thought it would give rise to a spate of litigation. In its 30 months or so of life to date, there have been well over 100 court decisions involving NEPA and its procedures dealing with such questions as when NEPA is applicable; what elements must be considered in NEPA statements; who and what interests must and may participate in the NEPA process; etc. The same thing can happen to technology assessment.

Finally, it should be recognized that the process of technology assessment discussed today is neither the beginning point nor the ending point in society's assessment of technology. Society has always had mechanisms for technology assessment. Today, the market place, the legal system, and the insurance mechanism all play an important role in technology assessment. If an institutionalized technology assessment mechanism is created, this will be superimposed upon and supplement the existing structure. The outputs of this assessment mechanism, assuming they are reflected in legislative action, will not be self-executing. They will merely change the rules of the game, and the marketplace, the legal system, and the insurance

mechanism will continue to perform their own assessment functions under the new rules.

It is interesting, I believe, to note that the legal profession has shown relatively little interest in technology assessment. This is perhaps due to the fact that those from other disciplines who have been immersed in the assessment problem have not adequately recognized the relevance of legal institutions in technology assessment and therefore have not called for the lawyers' help. On the other hand, it may be that from the standpoint of the legal profession, the old maxim is relevant: "The more things seem to change, the more they are the same."

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V. CASE STUDIES

A. Early Experiences with the Hazards of Medical Use of X-Rays: 1896-1906

Barbara S. MARX

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OPERATION OF THE TECHNOLOGY ASSESSMENT PROCESS IN EARLY EXPERIENCES WITH THE HAZARDS OF MEDICAL USE OF X-RAYS

A period of diffusion typically precedes the assessment of hazardous effects of a technological innovation, unless the hazardous effects have been persuasively conjectured or extrapolated from the known hazards of similar situations. During the initial stage of the diffusion process the technological innovation is tried out in a preliminary way, and the basic questions of What is it? How does it work? and What can it do? are generally answered.

The initial stage of the diffusion process is then followed by a process embodying some kind of technology assessment--which may be directed toward examining a great number of different effects, good and bad, resulting from the technological innovation; or may look mainly at socially detrimental effects; or in a still narrower focus, may evaluate hazardous effects.

This paper will now consider the characteristics of the technology assessment process which were manifested in response to the hazardous effects of early medical uses of X-rays. In the interests of better organization of the analytical material, I wish to propose a model to describe the early stage of the technology assessment process with respect to medical X-rays. The model may be thought of as consisting of working hypotheses about the process.

1. Tentative Model Describing the Major Phases in the Early Stage of the Technology Assessment Process--The major phases of a technology assessment process directed toward the evaluation of hazards consist of: (1) identification, (2) assessment, and (3) control. These phases may proceed in a relatively orderly or disorderly way, may occur quite continuously or take place in a sporadic interrupted way, and may follow the identification-assessment-control sequence in such a way that the phases are relatively discrete or, on the other hand, are relatively overlapping. Typically the phases overlap and in part cannot be clearly distinguished; nevertheless the categorizing notion of three major phases is helpful in characterizing the types of assessment activities predominating during each phase.

(a) Identification Phase--The identification phase of the early stage of the technology assessment process is comprised of two sub-phases. The first consists of collecting preliminary information about the hazards. Two main types of activities may be thought of as occurring. A body of information is gradually accumulated about the immediate and relatively immediate hazardous effects of using a particular technological innovation. In addition the information about the hazards is winnowed and integrated to resolve the discrepancies in a preliminary way. The outcome of the first part of the identification phase is to arouse information needs

relating to the two general questions of What are the causes of the hazardous effects?--an identification problem--and What should be done about the hazards?--which is more an assessment problem.

The other sub-phase of the identification phase is represented by activities which collect preliminary information about the causes of the hazards and the cause-effect relationships. During this sub-phase the following activities are likely to occur: debate about causes, collection of new information, and partial resolving of disagreement about facts, terms, and concepts--for example, What are the severe hazards? What really happened in the severe cases? To how many persons, or with what frequency? What are the definitions of the terms being used? The outcome of the second sub-phase of the identification phase is to generate information needs relating to the general assessment question of What are the remedies for the generally agreed upon causes?

(b) Assessment Phase--The assessment phase of the early stage of the technology assessment process consists of acquiring information about possible remedies and determining their effectiveness. Again, the collection of information, debate, and some form of resolution of the disagreements are activities that typically occur. The outcome of the assessment phase is to arouse information needs pertaining to the question of How

may the remedies be most effectively applied? and What control actions should be taken to implement them?

(c) Control Phase--The control phase of the early stage of the technology assessment process is marked by activities which focus on means of controlling the hazards. Typically these activities are related to and concerned with the setting of informal standards and the establishment of some kind of monitoring structure.

2. Brief Run-Through of the Model, Fitting in the Data. In order to give the reader a general impression of the fit of the model to the data, we will run through its major phases and show how these relate to the activities occurring during the early assessment of hazards of medical X-rays. In categorizing the activities in terms of the phases, it must be remembered, as previously cautioned, that the phases and activities comprising them are not necessarily altogether orderly, continuous, discrete, or in the specified sequence. Discrepancies and overlap exist. But on the whole the patterns of events fit the formulations of the model.

(a) The Identification Phase and its Activities--The medical X-ray pioneers began knowing only what the rays could do--i.e., make a "shadow" picture of certain anatomical structures beneath the skin; they did not know what X-rays were, or the damages which could result. X-rays were a mysterious form of "light" that was not accompanied by the sensation of heat. Therefore exposing human tissues to X-rays seemed as harmless as exposing

it to daylight. Nothing was known about suitable exposure distances, frequencies, or time-lengths, or about the varying intensities of rays discharged by various devices then utilized. But since X-rays were thought to be perfectly safe, these issues did not seem very important. For this reason also, animals were not used to answer experimental questions about the effects of X-rays.

However, within the first year of use an awareness had already developed of some of the immediate adverse effects. In 1897, a number of medical articles had described adverse effects consisting mainly of "burns," but also of unhealing sores, depilation, and other injuries. Initially it was thought that just the skin was affected, and only several years later was it realized that underlying anatomical structures could be injured. Although throughout the decade, information was accumulated about the benefits and hazards of X-rays, within the first years the immediate and many of the relatively immediate hazards had been described and identified.

The other sub-phase of the identification phase followed, with only a very short lag-time between it and the first sub-phase in which the nature of the hazards was identified. Thus the two sub-phases overlapped for the most part. As can be expected, the identification of causes led to much more debate. In 1897 there had been some conjecture about the causes of X-ray injuries, and this swiftly increased, with active debate continuing until at least 1901. The burns were attributed

to ozone, chemicals, germs driven into the tissues, electrolytic actions of the current, static electricity, and particles. The X-rays themselves were not strongly implicated as a cause until Thompson made this point near the end of 1898. Even so, while history proved Thompson correct, his views were not widely accepted until several years later.

Other subjects of debate related to facts, terms and concepts. It was not clear with what frequency injuries occurred, or what were the accompanying circumstances that would explain why only some individuals suffered ill effects.[98] In 1897, Scott had reported the puzzling fact that the data he collected showed a mere 69 cases of injury out of an estimated 20,000 exposures. But reports of additional cases of injury continued to be made. Even so, the significance of Scott's data was questioned, with the contention that it was not known whether the injuries were actually caused by X-rays.

One concept that persisted for a long time was that X-rays were not really harmful. During the debate about causes and frequencies of injury, the typical statements of reassurance and debunking of ill effects were made, predictably confusing the picture. For example, in 1898 Monell prophesied that the problem of X-ray burns would fade out of existence with the new improved equipment. He confidently asserted, "It is <u>easy</u> to avoid injuries during X-ray work; it is difficult to cause [them] ." Periodically during these years, statements were

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98 In 1900, both Scott and Kassabian had suggested the possibility of differing individual susceptibilities, but apparently the suggestion was ignored for some time.

made that X-ray burns were not a problem and that there was practically no danger. In 1901 Williams remarked with similar confidence: "There is no reason for anxiety in regard to ill effects." And two years later he contended that the frequency of injuries had been greatly exaggerated.

To the reader of today, one of the more distressing debates was the semantic one relating to the definition of a burn. Up till then it was supposed that burns were caused only when detectable heat was generated. Thus an "X-ray burn" seemed a contradiction in terms. The argument over whether the common form of injury should be termed a burn absorbed attention and energy which might have been better spent. In retrospect the issue seems to have been a dead-end that delayed the assessment process and contributed to the sources of disagreement and confusion.

(b) The Assessment Phase and its Activities--The assessment phase consisted of acquiring information about possible remedies and examining their effectiveness. As early as 1898 some safety precautions were recommended, and in the next years the question of how to prevent injuries received more consideration. It may therefore be seen that the early part of the assessment phase overlapped a great deal with the identification phase. However, it was very rudimentary assessment, and the amount of space relegated to precautions in the medical articles was very small compared with space devoted to the identification

of causes.of injury. The remedies suggested show how little was really known then about the causes. The importance of distance between the patient and X-ray tube was emphasized early, and it was thought that excessive exposures lasting an hour or so could lead to adverse effects. The other remedies suggested--such as using an aluminum screen or silk sheet to protect the patient--were later on realized to have little relevance. In 1897 Thompson had observed that heavy lead glass had a shielding effect, but the implications were not recognized until much later. Discussion about causes of injuries and their prevention still focused mostly on the patient, whereas the effects upon the practitioner were little considered.

By 1903 Williams suggested coating the X-ray tube with white lead paint and using leaded glass to protect the operator's eyes. We see that with medical X-rays, during the early stage of the technological assessment process, relatively few activities can be classified as fitting into the assessment phase, for during the first decade of use very little information about possible remedies had been developed.

<u>(c) The Control Phase and its Activities</u>--Even fewer activities may be viewed as pertinent to the control phase. There were some efforts near the end of the decade to apply some fairly generally agreed upon precautions, but not in any systematic way. The control phase, in the initial stage of technology assessment of medical X-rays, falls mainly outside the time period

studied in this paper. It was soon after to be marked by the realization that ways of measuring the intensity of X-ray exposures would have to be developed, so that some informal standards could be described and applied.

<u>3. Possible Characteristics of Subsequent Stages of the Technology Assessment Process</u>--The formulations about the phases of the early stage of the technology assessment process have been based for the most part on analysis of the data presented in Part I of the paper. If these formulations are somewhat speculative, those referring to the possible characteristics of subsequent stages in the process must be deemed even more speculative. It is, however, conjectured that the technology assessment process during its later stages recycles through the phases of identification, assessment, and control but very probably with a number of notable differences.

One apparent difference is that the early stage's phases are characterized by relatively informal and rudimentary efforts to establish: (1) the nature and causes of the hazards, (2) the most effective remedies, and (3) the type of control actions which should be taken so the remedies will be adequately applied. By contrast, in the later stages of the technology assessment process the activities seem to become more formal or codified, more intensive, and more sophisticated. More subtle concepts of the hazards and their causative factors emerge. At the same time the phases of identification, assessment, and control interpenetrate much more, with the result that they are less sequential.

Related to this is very likely another important difference between the early and subsequent stages in the technology assessment process. There appears to be a trend for the stages to move from a simple form of the assessment process to a complex form, with each stage becoming increasingly more complex. Rarely does a subsequent stage seem to be simpler than the one preceding it, in terms of the number of participant structures and information dissemination structures. Consequently perhaps the dilemma of the early stage of technology assessment is that, although the participant structures and information dissemination structures are quite simple and easy to deal with, little tends to be known about the hazards and little exists in the way of formal regulatory structures. Correspondingly, perhaps the dilemma in the later stages of assessment is that while more is known about the hazards and more regulatory structures have evolved, the increasingly greater number of participant and information dissemination structures, and the fragmentation of the assessment process they cause, verges on the chaotic. The result is to overtax the capabilities of whatever overall decision-making and administrative bodies exist.

This paper has presented data depicting representative early experiences with the hazards of medical X-rays during the first decade of their use. The reasons for the rapidity of the initial diffusion of X-ray applications have been discussed in considerable detail, and a simple model of the diffusion process suggested.

Some comparisons between X-ray diffusion "then" and "now" were outlined, with emphasis on changes which have occurred in the amount of information available and in the medical communication network. Then, based on analysis of the kinds and sequences of activities found in the data, a tentative model was proposed describing the major phases in the early stage of the technology assessment process. In the concluding section, conjectures were made about what differences might distinguish the early stage of technology assessment from its later stages.

Although in this preliminary study no effort has been made to demonstrate the detailed fit of the model of the technology assessment process to the events set forth in the data, if the reader runs through the phases and sub-phases of the model and systematically plugs in the data, he will find that the evidence here strongly substantiates the model. But the proof of the model is what it can do. If the present formulation looks promising, then to be of value the model will require further development. Further work with the model should be useful in testing and refining it, and appraising to what extent it can be used as a tool for investigating and analyzing the process underlying other technology assessment situations.

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V. CASE STUDIES

B. Controlling the Potential Hazards of Government-Sponsored Technology

Michael J. WOLLAN

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Controlling the Potential Hazards of Government-Sponsored Technology

MICHAEL WOLLAN*

Introduction

Side effects of science and technology today threaten to overrun our means of controlling them. Air and water pollution, power blackouts, radiation damage and many other technologically-created hazards have had the sobering effect of impressing many public officials with the need for wise management of scientific and technological change. In Congress this concern is being focused on Congressman Emilio Q. Daddario's Subcommittee on Science, Research and Development of the House Committee on Science and Astronautics, which is holding hearings and seminars on methods of "identifying, assessing, publicizing and dealing with the implications of applied research and technology."[1] In the executive branch, the Office of Science and Technology is discussing proposals for a Fourth Branch of Government that would anticipate and control the medical, social, political and economic ramifications of applications of science and technology.

Moreover, numerous examples from the recent history of technological change demonstrate that an essential part of the planning for technology assessment must be the continuation of assessment *after* government policy with respect to a scientific or technological innovation has been initially developed. For instance, fifteen years after atomic weapons tests were performed in Nevada, health authorities in Washington County, Utah, felt the need to ex-

* Research Associate, Program in Law, Science and Technology, National Law Center, The George Washington University. B.A., University of Chicago; LL.B., Yale University.

1. Technology Assessment, statement issued by Emilio Q. Daddario, Chairman, Subcomm. on Science, Research and Development of the House Comm. on Science and Astronautics, 90th Cong., 1st Sess., at 3 (1967) [hereinafter cited as Daddario Statement].

amine children for possible effects of fallout from the tests. Many years after the introduction of the internal combustion engine, we began to appreciate the seriousness of pollution problems caused by tetraethyl lead in automobile fuels. And after the Navy systematically sprayed an island off the coast of New Jersey during World War II to eliminate hoards of flies it discovered that the spray, DDT, killed fish.[2]

The need for re-assessment has been particularly apparent with respect to drugs and chemicals that people regularly consume, because medical knowledge of the effects of chemical compounds on people is constantly changing. The Food and Drug Administration, for instance, requires that all reports of adverse effects of drugs be submitted to its specialists for study, even after the drugs have been approved for sale and distribution. A recent survey of leading chemists and biologists in the United States indicates that many scientists who endorse fluoridation as a public health measure also believe that continued research on the effects of fluorides on human beings is desirable. The fact that fluoridation involves the regular ingestion of a chemical whose effects were not fully understood or examined at the time it was endorsed by the Public Health Service underscores the need for continuing assessment.

Although the concept of Technology Assessment is not new,[3] the present patterns of massive federal support of research and development were stimulated by World War II and now have led almost every government agency into programs that involve applications of science and technology.[4] Who assesses the impacts of these programs; for what purposes; through what means, mechanisms and procedures; and, with what results? These are questions this article analyzes by case studies that provide some insight into how the technology assessment function is currently being performed.

Weather Modification

Since the evolution of the most primitive societies, men have attempted to control their environment by modifying the weather.[5] In the United States, Congress, in 1890, sponsored early scientific efforts to make rain, when the Department of Agriculture received $9,000 to produce rain by setting off explosives in the clouds.[6] Not until 1946, though, were controlled laboratory ex-

2. For an interesting discussion of these and similar problems, see Commoner, Science and Survival (1966).

3. As early as 1830 our Federal Government began to assess technology. A series of boiler explosions on steamboats brought pressure on the Congress to take corrective action. Lack of information on why boilers burst prompted Congress to direct the Secretary of the Treasury to act. In turn, the executive branch, unable to make much headway granted research funds to the Franklin Institute of Philadelphia to conduct experiments to produce the body of data necessary to locate flaws in design, construction, and theory of steam boilers. Regulatory legislation eventually resulted.

Daddario Statement, *supra* note 1, at 10.

4. For a description of federal support of science and technology, see XVI Nat'l Science Foundation, Federal Funds for Research, Development and Other Scientific Activities (1967).

5. *See* Halacy, The Weather Changers (1968).

6. Baum, Congressional Action on Weather Modification (paper for Symposium on Weather Modification, Am. Ass'n for the Advancement of Science, N.Y., Dec. 30, 1967).

periments used to demonstrate a method of increasing precipitation by seeding clouds with pellets of dry ice. In the 22 years since these experiments were performed at General Electric, weather research has progressed to such an extent that scientists are now able to produce significant changes in rainfall, tornadoes, lightning, hail and fog. "[I]n a sense, weather modification today is a reality. Man can and does interfere with the atmosphere in a number of different ways. His ability to produce deliberate beneficial changes is still very limited and uncertain, but it is no longer either economically or politically trivial."[7]

For many years novel legal problems raised by rainmaking have puzzled the courts. For example, in the late 19th century, when a severe drought struck northern New York, a minister named Duncan McLeod organized a community prayer session to ask for rain. Within three hours a tremendous storm blew over the area, bringing two inches of rain. Lightning destroyed a barn owned by Phineas Dodd, who had been the only person in the community who openly objected to the prayer session. Dodd promptly sued Reverend McLeod for $500, arguing that the loss of the barn was a direct result of the prayers he organized. Defense counsel finally persuaded the court that defendant had only prayed for rain, and the lightning had been a gratuitous gift of God.[8]

As the range of controllable weather phenomena expands, more complex biological, ecological and political problems arise. For instance, suppose we are able to prevent hurricanes from battering the coast of Florida by redirecting them into the Atlantic or the Caribbean. How will other countries in the area be affected? What diplomatic approaches are necessary to work out arrangements which will allow us to protect Florida from hurricane damage without deliberately inflicting this damage on another country? How will our ability to control rain and snowfall affect biological communities? Will reproductive cycles be influenced, and if so, how? More important, will weather modification methods become instruments of warfare? What steps should be taken to assure that the benefits to society of weather control will be maximized and the hazards minimized?

Generally, definitions of weather modification encompass both intentional and inadvertent changes in atmospheric processes, motions or compositions. Intentional changes include rainmaking and control of lightning, hail and severe storms, while inadvertent changes usually refer to the consequences of air pollution.

Major programs of the federal government to modify the weather deliberately began after World War II, and have gone through three stages: 1) the period from World War II to 1958, 2) 1958-1965, 3) 1066 to the present.

7. I Nat'l Academy of Sciences, Weather and Climate Modification: Problems and Prospects 3 (1966) [hereinafter cited as Nat'l Academy of Sciences].
8. Partidge, Country Lawyer ch. 7 (1939).

Stage One: Early Federal Involvement

Although the Congress supported isolated weather modification experiments around the turn of the century, long range federal programs of weather control research did not begin until after World War II. In 1947 the armed services initiated investigations of cloud modifications through Project Cirrus, since the Air Force was interested in the advantages increased knowledge of cloud behavior would provide for fliers. Project Cirrus was followed in 1952 by a Department of Defense five year Artificial Cloud Nucleation Project.

These early projects were confined primarily to research for military purposes, and were conducted on a small scale compared with the multi-million dollar activities of commercial rainmakers in the early 1950's. Rainmaking companies were responsible for most advances in non-military applications of weather modification in the first decade after the War as droughts in several sections of the country aroused considerable concern, particularly among farmers, and private organizations were often hired to try to increase precipitation.

After 1950 a number of Congressmen began to think more seriously about the possibilities of the federal government sponsoring research into civilian uses of weather modification. Fear that the Soviet Union might develop weather control knowledge that could be used to disrupt American agriculture, coupled with concern about drought in the West, led Congress to consider an evaluation of the current state of knowledge of the weather. In 1953, Congress created the Advisory Committee on Weather Control, headed by Retired Navy Captain Howard Orville, to "make a complete study and evaluation of public and private experiments in weather control for the purpose of determining the exte... which the United States should experiment with, engage in, or regulate activities designed to control weather conditions."[9]

Although the Orville Committee's primary task was to review existing capabilities for weather modification, Congress was aware of some possible adverse consequences of experimentation with the weather. The Statement of Purpose and Policy which Congress adopted for the Committee noted that weather control "without proper safeguards, sufficient data, and accurate information may . . . adversely affect the general welfare and common defense."[10] The bill setting up the Committee declared it to be the policy of Congress to prevent the "harmful and indiscriminate exercise" of "experiments and operations designed to modify and control weather."[11]

The Committee's final report, issued in December, 1957, provided Congress with the first complete review of weather modification research in this country. Given the data of the report and its recommendations for vast expansion of government-sponsored research, Congress was ready to advance to the next stage in the development of national weather modification programs—selection of agencies to sponsor research, and appropriation of funds.

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9. 99 Cong. Rec. 10660 (1953).
10. *Id.*
11. *Id.* The Committee devoted relatively little attention to these problems.

Stage Two: The Growth of Federal Programs

Public Law 85-510. At the urging of the Orville Committee, Congress in Public Law 85-510, approved July 11, 1958, designated the National Science Foundation to "initiate and support a program of study, research, and evaluation in the field of weather modification . . . ."[12]

During the hearings on 85-510, two arguments, frequently repeated, were most influential in persuading Congress of the need for establishment of long-range national weather modification programs. First, as Senator Francis Case pointed out,

> [E]conomically the possible importance of this bill to the Nation and to the world is tremendous. . . . We spend hundreds of millions of dollars to counteract and alleviate weather caused disasters, or, I might say, to overcome situations created by a lack of knowledge about the weather or what is coming. It is my earnest conviction that what the Congress does to authorize an orderly experimentation and evaluation program in cloud modification will have lasting significance for conditions of drought, floods, hurricanes, hail, lightning, fog, and smog.[13]

Second, a number of Senators and Congressmen were greatly concerned about the possibility that the Soviet Union would progress more rapidly than the United States in the field of weather control. They were troubled by the testimony of Dr. Edward Teller, who asked the House Commerce Committee to "Please imagine a world in which the Russians can control weather on a big scale, where they can change the rainfall over Russia, and that—and here I am talking about a very definite situation—that might very well influence the rainfall in our country in an adverse manner."[14]

Little attention was paid during the congressional hearings and debates to possible adverse consequences of weather modification or the likelihood of detrimental results of experiments.

Under 85-510 NSF promptly established a program of research, through grants and contracts, to study further the scientific bases of weather and climate modification. In the program's first year of operation, \$1.141 million were spent.[15] Funds for the program continued to be appropriated at the rate of between one and two million dollars a year, gradually increasing to \$3.5 million in 1968.[16] While NSF has allocated this money to support basic scientific weather research, other agencies, mainly the Departments of Agriculture, Commerce and the Interior, have slowly and independently built their

12. 42 U.S.C. § 1862(a)(9) (1964).
13. *Hearings on Weather Modification Research Before a Subcomm. of the House Comm. on Interstate and Foreign Commerce*, 85th Cong., 2d Sess., at 8 (1958).
14. *Id.* at 9.
15. Nat'l Science Foundation, Ann. Rep.: Weather Modification 3 (1959).
16. Interview with Peter Wyckoff, Program Director for Weather Modification, Nat'l Science Foundation, in Wash., D.C.

own programs to investigate uses of weather control specifically of interest to them.

Development of Programs in the Other Agencies. The Bureau of Reclamation, in the Department of the Interior, has financed limited research into snow and rainfall for over seven years because of its interest in water resources in the Western states. Until 1964 these efforts only received about $100,000 a year in financial support from Congress, but then Senator Alan Bible of Nevada and other Senators from the West began to push for huge increases in appropriations for projects designed to augment water resources in the Upper Colorado River Basin.[17] Senator Bible, who was specifically interested in experimentation with methods of rainmaking, led a fight that secured an appropriation of approximately $1 million for the Bureau of Reclamation's weather modification research in fiscal year 1965. Since then, funds allocated to Interior's weather modification research and development programs have risen regularly. For fiscal year 1968 Interior will spend $5.1 million to control the weather —almost fifty per cent more than any other agency, including the National Science Foundation.[18]

During the same period, the Department of Agriculture has pursued its programs of lightning suppression, spending the modest amount of one to two hundred thousand dollars a year.[19] The Federal Aviation Agency's research into fog dispersal has cost even less each year, while the National Aeronautics and Space Administration and the Department of Defense have similarly allocated money for a few small-scale weather control projects.[20]

The Department of Commerce is the only other agency that has made major efforts to expand its weather and climate control programs since the Orville Committee submitted its final report and Congress enacted Public Law 85-510. Until 1966, Commerce support of weather modification never rose above $250,000 a year due to the skeptical view which its Weather Bureau had toward the future of weather control. In the past three years, however, the Department's Environmental Science Services Administration (ESSA) has enthusiastically promoted a wide range of weather control projects, including efforts to modify hurricanes, increase rainfall, divert the energy of tornadoes and suppress hail. This year ESSA will spend $1.5 million on weather modification, and hopes to triple that amount by 1970.[21]

To avoid duplication of weather modification projects, the agencies engaged in weather research have used an Interdepartmental Committee for Atmospheric Sciences to exchange information and coordinate programs. Annual meet-

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17. *Hearings on Progress in Weather Modification Before the Subcomm. on Water and Power Resources of the Senate Comm. on Interior and Insular Affairs*, 90th Cong., 1st Sess., at 11 (1967).

18. *Hearings on Weather Modification Before the Subcomm. on Communications and Power of the House Comm. on Interstate and Foreign Commerce*, 90th Cong., 1st Sess., at 42 (1967) [hereinafter cited as *Hearings on Weather Modification*].

19. Nat'l Academy of Sciences, *supra* note 7, at 15.

20. *Id.* Exact amounts being spent by the Department of Defense are not public since many of the projects are classified.

21. *Hearings on Weather Modification*, *supra* note 18.

ings of all officials involved in weather control are arranged by ICAS to encourage exchanges of ideas and reports on successes and failures met by each agency. ICAS does not attempt to plan or regulate the Government's weather modification activities. Occasionally, the Committee may recommend that one agency eliminate a proposed experiment because similar work is being undertaken by another agency, but in general, ICAS serves only as a clearinghouse for information on federal weather modification research.

As Interior, Agriculture, the FAA, ESSA and NASA have joined the National Science Foundation in support of weather modification efforts in the past ten years, their programs have focused primarily on establishing the *feasibility* of scientific methods for controlling the weather. Interior, because of its mission-oriented projects in the area of water resources, has sought to find ways of augmenting precipitation. Agriculture, because of its responsiblities for the farm economy, has been interested in how weather control can reduce crop damage. The FAA, because of its concern for air safety, has tried to find methods of removing heavy fogs that hang over airports. In general, all of these government programs have endeavored to overcome skepticism among many scientists about man's ability to subject the weather to his control. But almost no studies or funds were devoted to investigation of the legal, biological, ecological or social consequences of weather modification throughout the late 1950's and early 1960's.

Appointment of NSF and NAS Study Groups. By 1963, a number of Administration people and some Congressmen felt that a general reevaluation of the results of weather modification, similar to the study of the Orville Committee, was due. On October 17 NSF's National Science Board authorized appointment of a Special Commission on Weather Modification to review the "state of knowledge on weather and climate modification, make recommendations concerning future policies and programs and examine the adequacy of the Foundation's program."[22] In November, the National Academy of Sciences also appointed a Panel on Weather and Climate Modification "to undertake a deliberate and thoughtful review" of the status of weather modification and its potential.[23]

The NSF and NAS study groups were closely connected from their conception, since NSF provided fifty per cent of the money for the NAS study.[24] To avoid duplication of their efforts, and to assure that the many complex problems of weather modification received adequate treatment, the two organizations agreed that NSF would concentrate on the non-scientific aspects while the Academy would focus on scientific and technical matters. Together the two

22. Special Comm'n on Weather Modification, Nat'l Science Foundation, Report on Weather and Climate Modification 6 (1965).
23. Nat'l Academy of Sciences, *supra* note 7, at vii.
24. *Id.* at ix.

hoped to provide a comprehensive analysis of what had happened in weather modification programs since the Orville Committee report. As the NAS Panel explained later in the preface to its final report: "The complexion of the field had changed subtly since the appearance in 1957 of the final report of President Eisenhower's Advisory Committee of Weather Control. It was time for a new and broader evaluation."[25] The Panel and the Special Commission completed their work within a month of each other. The published results ushered in the next stage in the development of federal weather modification policies.

Stage Three: Emergence of New Dimensions in Federal Policy

The NAS and NSF Reports. In November, 1965, the National Academy's Panel submitted its final report,[26] followed a month later by the conclusions and recommendations of the NSF Special Commission.[27] In a careful, detailed review of progress with respect to modification of clouds, cloud systems, climates in large areas and climates in local and regional areas, the Panel concluded that scientific means for bringing about limited forms of weather control were already available, and investment of large sums of federal money promised even more progress in the immediate future. Given this persuasive evidence that "weather and climate modification is becoming a reality,"[28] the NSF Special Commission sought to make the public, the scientific community, the Congress and other government agencies aware of five crucial questions:

1) What may be the biological consequences of weather and climate modification activities?

2) What might be the social, human and economic benefits to man?

3) Are there legal, political and legislative issues to be resolved?

4) How should the plans of the United States in weather and climate modification be communicated to and coordinated with other nations?

5) What are the organizational and funding needs for a national program in weather and climate modification?

None of these questions were thoroughly answered in the report, but the need to explore them in depth was spelled out explicitly. For instance, commenting on biological implications, the report noted that

> Anything that has a general and significant effect upon plants and animals, making some more abundant, others less so, is of primary concern to mankind, for it strikes at the very basis of human existence. Changes in weather and climate may be expected to have such effects. It follows that any program of weather and climate modification must give serious attention to adverse as well as beneficial biological aspects.[29]

Regarding social effects, the report mentioned that

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25. *Id.* at vii.
26. I & II Nat'l Academy of Sciences, Weather and Climate Modification: Problems and Prospects (1966).
27. Report on Weather and Climate Modification, *supra* note 22.
28. *Id.* at 8.
29. *Id.* at 18.

> As indicated by the lack of social research about weather modification since the 1957 report of the Advisory Committee on Weather Control, when uncertainty concerning the feasibility of extensive weather modification is large the social implications tend to remain unexplored until a major problem erupts. The Commission feels strongly that this should not be the course of events in the future. All agencies engaged in weather modification attempts should give systematic attention to the social implications.[30]

And with respect to international problems, the report concluded that

> Looking into the future to the time when field experiments with weather or climate modification are expanded in scope and number and involve actual attempts to introduce changes in the atmosphere, some form of international collaboration will be essential in the planning and execution of projects. . . . Thought must be given to the types of international organizations that will be needed, and the functions they should perform . . . .[31]

Both the NSF and NAS reports urged expansion of federal programs of research and recommended that the level of funding be raised from $9 million a year in 1967 to $30 million by 1970. They also suggested that program direction be assigned to a single agency, although both qualified this point by stating that "a degree of delegated responsibility should be maintained that will allow other agencies to meet their mission requirements for work in this field."[32]

Impact of the Reports. The NAS and NSF reports acted as catalysts, immediately prompting wider debate on the non-scientific problems of weather modification and on the question of how federal weather research should be structured. To follow up on its own recommendations for research into the social aspects of weather control, NSF established a Task Group on the Human Dimensions of the Atmosphere, to determine ways in which research on the human dimensions of weather modification might be encouraged, and to outline types of research requiring most urgent attention. The Task Group's final report is expected this summer. NSF also arranged for Southern Methodist University to sponsor a conference in December, 1967, on the Legal Implications of Weather Modification Activity.

In addition, other agencies connected with weather modification programs have in the last two years undertaken independent studies of various social, legal and ecological effects of weather modification. The Interior, Commerce and Agriculture Departments have contracted with several universities to study such issues as federal liability for damages due to weather modification experiments, the effects of experiments on crops, and the effects of increased precipitation on plants and animals in localized areas. These studies are now in progress.

30. *Id.* at 23.
31. *Id.* at 26-27.
32. Nat'l Academy of Sciences, *supra* note 7, at 21.

Moreover, the agencies have begun to think more about how to structure federal weather modification programs so that the non-scientific consequences would be regularly taken into account in the planning and execution of projects. On March 29, 1966, Dr. Donald F. Hornig asked ICAS to prepare a report on the organization of federal weather control programs.[33] Dr. Homer E. Newell of NASA agreed to write the report, and in November he submitted a "Recommended National Program in Weather Modification." Newell strongly expressed his feelings that "there must be regulation and control of weather modification activities . . . to provide a mechanism for protection against harmful consequences of weather modification but also to permit valid experimentation."[34] He added that "the regulatory body must not be one of the operating agencies participating in the National Weather Modification Program. To assign this responsibility to one of these agencies would immediately generate conflicts of interest, sow the seeds of dissension, and doom the efforts at regulation and control to endless frustration."[35]

Finally, the reports have led Congress to assume a more active role in assessing the economic and social impact of weather modification activities. Senator Warren Magnuson's interest in weather modification was aroused enough by the reports that he asked the Legislative Reference Service to prepare an extensive report on "Weather Modification and Control" for the Senate Commerce Committee.[36]

Thus, the NAS and NSF reports in effect added new dimensions to the development of weather modification policies by stimulating greater interest in non-scientific issues and in regulatory structures that would attempt to further scientific progress in weather control while minimizing the hazards such progress might create for the public and the environment.

The Current Status of Weather Modification. The surge of interest during the past two years in assessment of the social consequences of weather modification has not meant that programs of research or experimentation on methods of weather control have been curtailed. On the contrary, the programs of NSF, Interior, Commerce and Agriculture continue to expand, as the NSF and NAS reports recommended. For example, Project Stormfury, conducted jointly by ESSA and the Navy, will attempt this fall to disperse or change the direction of hurricanes in the Caribbean. ESSA this year will also be trying to reduce the huge levels of snow which plague the area around Buffalo, New York, and Interior has an extensive program for combatting the water shortage problems in the Southwest by modifying rainfall in the Rocky Mountains. In general,

33. Newell, NASA, Report on a Recommended National Program in Weather Modification to the Interdepartmental Committee for Atmospheric Sciences (1966) (Federal Council for Science and Technology, Executive Office of the President, Nov. 1966, preface).

34. *Id.* at 7.

35. *Id.* at 36.

36. Legislative Reference Service, Library of Congress, Report on Weather Modification and Control (1966).

$10.55 million will be spent on federal weather modification programs in 1968, compared with only $7 million in 1966.[37]

Congress has been prodded by the NSF, NAS and Newell reports (just as it was prodded ten years ago by the Orville report) to review the structure of federal programs and to consider the need for new legislation that would broaden the regulatory authority of the Government and assign direction of federal programs to a single agency. The bill receiving most attention, H.R. 9212, would give primary authority for weather modification research to the Department of Commerce, while allowing other departments to carry out programs in specified areas. Non-federal weather modification activities would be regulated by the Secretary of Commerce under authority granted by the bill. And responsibility for "thorough study and investigation" of social, economic, biological and ecological effects of weather modification would be delegated to the Secretary of Commerce.

Hearings on H.R. 9212 were held in October and November, 1967, by the House Commerce Committee, but at the moment the bill is still in committee. Committee staff members indicate there is little hope for passage this year. Until new legislation is enacted, weather modification programs will continue in the various agencies at levels depending on the appropriations each agency can obtain from Congress. Some of the social consequences will be studied, as they are now, under grants and contracts issued from each agency. Although there will be no systematic planning or centralized regulation of federal weather modification projects, ICAS will continue to compile information on them and advise the departments or agencies of possible duplications in their efforts.

Technology Assessment in the Field of Weather Modification—An Evaluation

Frequently important social implications of a scientific method or invention are discovered long after extensive use has been made of the particular device. For instance, when oil from the freighter Torrey Canyon polluted the English coast, thousands of gallons of detergents were used to restore beaches to their pre-disaster condition. Now scientists have discovered that the detergents were more harmful to birds, plants and marine life than was the oil.

In the field of weather modification, however, many scientists, Congressmen, and government officials are already aware of possible adverse consequences. No formal assessment institutions or mechanisms, and no major disasters, were necessary to *inform* those government officials or scientists who were responsible for initiating federal weather modification experiments of the

37. *Hearings on Weather Modification, supra* note 18; Nat'l Science Foundation, Ann. Rep.: Weather Modification 91 (1966).

existence of non-scientific ramifications of weather control. But the *level of concern* about the consequences of weather modification has changed since 1953, and two groups, the NSF Special Commission and the NAS Panel, were primarily responsible for shifting interest in these questions from general discussions to specific, analytical programs of study and research. Prior to 1965, despite the work of the Orville Committee, many people still doubted whether the future of weather modification was bright enough to justify expediture of large amounts of government funds in research programs or experiments. The National Academy's report eliminated almost all of these doubts. The NSF report, in turn, directed attention to the kinds of legal, ecological and biological problems which will occur more and more frequently as the number and range of weather control experiments expand.

For the purposes of understanding what institutions or mechanisms are the most effective instruments of technology assessment, it is important to note that the current level of interest in social consequences of weather modification was induced by groups which did not operate mission-oriented weather control programs. Government agencies *responded* to the reports of the NAS and NSF, but did little to investigate the non-scientific ramifications of weather control prior to publication of the reports at the end of 1965. A possible explanation for the failure of these other agencies to initiate such studies is that to Interior, or Agriculture, or the FAA, weather modification devices are merely tools to be used to accomplish its mission of conserving water resources, protecting farm crops or promoting air safety. The agency thus is likely to allocate its limited resources to programs that demonstrate the feasibility and applicability of weather modification. NSF, however, has broader responsibilities for financing scientific research and development in general.

As technology assessment institutions, NSF and the Academy Panel not only stimulated greater interest in some of the implications of weather modification, but they performed this function *prior* to the launching of weather control experiments affecting mass populations. Therefore, many questions about weather modification are now being studied by government agencies in *anticipation* of situations in which large numbers of people, plants or animals might be injured by reckless experiments.

Nevertheless, NSF, the NAS Panel and other existing agencies have limitations as assessment institutions that are dramatized by noting some of the issues in weather modification not being thoroughly treated:

1. *Who* should decide what region of the country will be the subject of a weather modification experiment, and *how* should that decision be made? These questions are important as long as there is uncertainty about the possible consequences of the experiment, and such uncertainty is present with most weather experiments today. For instance, some scientists believe it is possible to reduce the severity of some hail storms by seeding clouds. However, the seeding must take place at a critical time and altitude, or the severity of the storm might be increased instead of diminished. Thus, the question of how the decision is made to conduct the experiment in state X instead of state Y becomes significant. Should the people in the area be consulted? How much should

they be told about the risks involved in the experiment? The NSF and NAS reports dealt with questions of a more general nature, and the agencies currently engaged in weather modification programs have been reluctant to attempt to lay down guidelines for deciding these questions. Most officials connected with the programs feel that since they are aware of the possible serious consequences of experimentation, the public can trust them to conduct the experiments with a minimum of risk. Probably general regulations governing choice of sites, timing of experiments and notice to persons likely to be affected should be drawn up by an agency which would not have a mission-oriented interest in weather modification programs.

2. The National Academy's Panel, the NSF Special Commission and the Newell report to ICAS all urged that a federal regulatory structure for weather modification be established.The NAS recommendation was particularly strong:

> We recommend that attention be given immediately to careful monitoring and regulation of operational programs for weather modification. New legislation will be required, and this legislation should reflect the economic, political, social, and scientific implications of the programs. To ensure maximum overall benefit and public welfare, legislation should include means of assigning to a single federal agency, possibly created for this and related purposes, the responsibility for monitoring and regulating operations and ensuring the publication of full reports. Such an agency should have powers and resources to conduct independent evaluations, and may need the authority to adjudicate among conflicting projects.[38]

No regulatory system has been set up, although legislation authorizing regulation of non-federal operations has received some attention. H.R. 9212, pending before the House Commerce Committee, would allow the Secretary of Commerce

> after notice and opportunity for a hearing, to issue regulations governing the weather modification activities of any person or persons not engaging in such activities pursuant to contract, lease, cooperative agreement, grant, or other transaction with agencies of the Federal Government, which conflict with or impede any activities conducted under this Act and to encourage compliance with such regulations by such business concerns.[39]

There is little likelihood, however, of committee action on the bill this year.

Some limited rules governing weather modification projects have been issued by sponsoring agencies. For instance, in Project Stormfury's experiments with hurricanes, ESSA has informally ruled that "a hurricane in the southwestern North Atlantic will be considered eligible for seeding as long as there is a small probability (10% or less) of the hurricane center coming within

38. Nat'l Academy of Sciences, *supra* note 7, at 23.
39. H.R. 9212, 90th Cong., 1st Sess. § 205(a) (1967).

50 miles of a populated land area within the ensuing 24 hours."[40] This regulation reflects ESSA's understanding that its experiments may not produce the hurricane behavior predicted, and therefore steps must be taken to protect people and property in the Caribbean or North Atlantic that might be adversely affected by experiments.

In general though, there has been much reluctance to create a regulatory agency or to issue broad regulations that would limit weather modification experiments conducted by the federal government.[41] H.R. 9212 would apply only to *non-federal* activities, and the agencies involved in federal activities have not attempted to develop detailed regulations for weather control projects.

There are two basic reasons why, despite the conclusions of the NAS Panel, the NSF Special Commission and the Newell report, a federal regulatory structure for weather modification has not emerged. First, the operating agencies are hesitant to allow a new agency such as a National Weather Modification Commission to have the power to regulate the manner in which their experiments are selected or conducted, fearing that a Commission might, through unnecessarily conservative regulation, restrict current rates of progress in the atmospheric sciences. The agencies are also unwilling to allow an existing department to be given general regulatory authority because of the possibility that programs in one agency will then be given priority over those in another. For example, Interior opposes the provisions in H.R. 9212 that would give primary responsibility for weather modification research to the Department of Commerce. Second, because of the pressing problems of the Vietnam War and of the cities here, no pressure has developed in Congress to act on H.R. 9212 or other legislation dealing with regulation of weather modification.

The longer Congress waits to enact legislation which would create regulatory mechanisms in the field of weather modification, however, the more difficult it becomes to overcome the resistance of established programs to a central regulatory authority. Thus, while the NSF, NAS and Newell reports, as assessment reports, have succeeded in raising issues connected with the science of weather modification and in prompting further studies of the issues raised, their impact on the organization and regulation of government weather modification programs has been minor.

Engine Noise from the Supersonic Transport

The federal government's decision to construct a supersonic commercial airliner (SST) in conjunction with private industry has been subjected to a con-

40. Environmental Sciences Services Administration, U.S. Dep't of Commerce, Project Stormfury Fact Sheet 3 (Aug. 1967).

41. *E.g.*, S. 373, 90th Cong., 1st Sess. § 303 (1967), introduced by Senator Magnuson in January, 1967, would require that an agency obtain prior approval of Congress before conducting weather modification operational activities. Agencies that submitted their views on the bill to the Commerce Committee urged deletion of the section.

tinual evaluation or assessment by a number of writers and members of Congress.[42] Controversy over the SST has centered on three questions:

1) What hazards are presented to the public and to property by the plane's sonic boom, and what limitations will these hazards place on air routes for the plane?

2) How much financial support for the projects should come from the federal government, and what return should the government receive on its investment?

3) To what extent should issues of national prestige determine whether or not the government underwrites the design and construction of the plane?

A fourth issue, the amount of noise created by the jet engines of the plane, has received little attention. Analysis of this issue, however, is of immediate importance and further illustrates the manner in which the technology assessment function is being performed in the federal government today.

Assessment Prior to the President's Announcement

Speaking to the graduating class of the Air Force Academy on June 5, 1963, President Kennedy gave his seal of approval to proposals for joint government-industry development of a commercial supersonic transport.[43] These proposals had been evolving since the mid-1950's, and had been reviewed for several years by numerous government officials, private citizens, industry representatives and members of Congress. The potential noise level of the plane's huge engines was among the issues frequently discussed.

At the first congressional hearings on the subject of a supersonic transport, held by the House Committee on Science and Astronautics in May, 1960, the noise problem was broadly defined.[44] Ira H. Abbott of NASA told the Committee that "As far as engine noise is concerned, the situation is not much different than for existing jet transports, except that more power will be needed and there will be a corresponding tendency for more noise."[45] Major General Victor Haugen of the Air Force testified that "engine noise, and its effects, as evidenced by sonic fatigue in aircraft structure and physiological discomfort or community annoyance, has been recognized for some time . . . . The higher power of the engines on the supersonic transports would make the problem more severe."[46] Two industry representatives added that the noise problem should not be taken lightly. The President of North American Aviation, Inc.

42. *See, e.g.*, Lardner, *Supersonic Scandal*, The New Republic, Mar. 16, 1968, at 13; Watkins, *SST Faces Drastic Cut in Weight*, Aviation Week & Space Technology, Mar. 11, 1968, at 28; 113 Cong. Rec. S14446 (daily ed. Oct. 9, 1967) (remarks of Senator Proxmire).

43. Kennedy, Public Papers of the President—1963, at 439 (1964).

44. *Hearings on Supersonic Air Transports Before the Special Investigating Subcomm. of the House Comm. on Science and Astronautics*, 86th Cong., 2d Sess. (1960).

45. *Id.* at 5.

46. *Id.* at 20.

commented that "At best, the sound problem is of major consequence,"[47] and a manager from General Electric, describing the type of engine capable of powering the plane, concluded simply: "It will be a noisy engine."[48]

Government officials at the 1960 hearing indicated that they were already thinking of the possibility of government imposition of noise standards for the plane. One NASA official involved in SST research programs said that an SST "must be socially acceptable in the sense that it must not cause undue noise at or in the vicinity of the airport or over the routes it will be flown."[49] FAA Administrator General Elwood R. Queseda repeated this concern: "A major premise which must be kept in mind from the outset in developing such an aircraft is that any need for increased power should be met without increased noise."[50] A year later, when Congress made its first appropriation for research on SST feasibility, the FAA discussed more specifically the standards it would use to regulate the SST's engine noise. FAA's new administrator, Najeeb Halaby, told Congress: "We would try to see to it that the noise levels were *tolerable to the community, or as tolerable as the then existing aircraft.*"[51]

To strengthen its understanding of potential problems of the proposed SST, the FAA solicited special reports on various aspects of an SST program. In July, 1961, an SST Steering Group comprised of the FAA administrator, the Assistant Secretary of the Air Force for Research and Development and the NASA Director of Aeronautical Research was established.[52] In December, 1962, this Steering Group received a report from its SST Advisory Group, consisting of ten members drawn from the airlines, airplane manufacturers, financial institutions and research organizations. The report included a warning that "the relationship between take-off performance and the noise generated at take-off must be such that public annoyance in airport communities is less than it is today."[53] "Approach and landing noise," the report continued, "must be no greater than that generated by present subsonic jet aircraft."[54] Other studies prepared for the FAA between 1960 and 1963 repeated this assessment.[55]

Assessment After the President's Announcement

After the President announced his support of a government-industry project to develop an SST, the FAA began to take further steps toward establishment of noise standards for the potential plane, and also explained more carefully the basis for its expectations regarding the plane's noise levels.

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47. *Id.* at 103.
48. *Id.* at 31.
49. *Id.* at 4.
50. *Id.* at 46.
51. *Hearings on Independent Offices Appropriations for Fiscal Year 1962 Before a Subcomm. of the Senate Comm. on Appropriations*, 87th Cong., 1st Sess., at 627 (1961).
52. *Hearings on Dep't of Transportation Appropriations for Fiscal Year 1968 Before a Subcomm. of the House Comm. on Appropriations*, 90th Cong., 1st Sess., at 307 (1967) [hereinafter cited as *Hearings on Dep't of Transportation Appropriations*].
53. SST Advisory Group, Report to SST Steering Group 10 (Dec. 11, 1962).
54. *Id.*
55. *Hearings on Dep't of Transportation Appropriations, supra* note 52.

June 5, 1963 to January 1, 1967. Two weeks after his speech at the Air Force Academy, President Kennedy submitted to Congress a program for development of the SST,[56] listing major decision points critical for the success of the plane and outlining objectives for the plane's design. Objective number seven sought "noise resulting from landing and take-off operations not greater than that presently created by the current international subsonic jet transports."[57]

On August 15, 1963, the FAA sent to manufacturers Requests for Proposals (RFP) for development of the SST that essentially incorporated this design objective as well as the FAA's previous statements to Congress on the plane's engine noise levels. The RFP informed potential contractors that "noise resulting from take-off operations shall be less than 112 PNDB [an arbitrary unit commonly used to measure noise levels from airplane engines] at a point on the ground one statute mile from the departure end of the runway . . ."[58]—a level that would compare favorably with commercial jets flying at subsonic speeds. Landing noise, according to the RFP, would have to be "less objectionable than that resulting from operations of current subsonic jets used in international service," and ground noise at the airport would have to be "reduced to a level tolerable to the average traveler and airport employee."[59]

The bases of the FAA's design objectives were elaborated by Administrator Halaby and Deputy Administrator Gordon Bain before the Senate Commerce Committee in October, 1963. Bain explained that although the engines for the SST will have to be more powerful than engines for subsonic jets, and therefore capable of producing much more noise, it is not likely that the aircraft would have to use its full thrust on takeoff. In addition, because of the plane's ability to climb at a rapid rate, "its noise level should be equal to or substantially less than current fanjets and we believe it will be less."[60] Halaby's opinion was that the combination of more powerful engines and more rapid climb would create "about the same noise" for the community as subsonic jets.[61]

Both Halaby and Bain admitted there would probably be a noise problem "on the runway as the pilot applies the power on the takeoff run."[62] "There is just no question," said Halaby, "but what [a subsonic jet with] four engines generating 18,000 pounds of thrust, for a transatlantic takeoff out of runway

56. *Hearings on Independent Offices Appropriations for Fiscal Year 1964 Before a Subcomm. of the Senate Comm. on Appropriations,* 88th Cong., 1st Sess., at 1984 (1963).
57. *Id.* at 1994.
58. FAA, Request for Proposals for the Development of a Commercial Supersonic Transport 20 (Aug. 15, 1963).
59. *Id.*
60. *Hearings on U.S. Commercial Supersonic Aircraft Development Program Before the Aviation Subcomm. of the Senate Comm. of Commerce,* 88th Cong., 1st Sess., ser. 35, at 73 (1963) [hereinafter cited as *Hearings on U.S. Commercial Supersonic Aircraft Development Program*].
61. *Id.* at 173.
62. *Id.* at 75.

13-L at Idlewild, will make less noise on the runway than [an SST with] four engines, developing 40,000 pounds of thrust. There is just no doubt about it."[63] Therefore, the FAA, in its RFP, instead of specifying that the noise levels be less than or equal to those of subsonic jets, called for levels "tolerable to the average traveler and airport employee."[64]

During 1965 and 1966 the engine designs were evaluated by the FAA and several other groups. One evaluation group consisted of 129 representatives of the Air Force, Navy, Civil Aeronautics Board, NASA and the FAA. Another was the President's Advisory Committee on the Supersonic Transport, chaired by Defense Secretary Robert McNamara. Nine United States airlines conducted their own investigations of the designs.

This evaluation process did not include a direct comparison of the noise levels potentially produced by the two engines.[65] Instead, the various committees focused on the type of engine required to power a plane with the qualities and dimensions which the Government sought. Of the two frame-design companies competing, the Boeing Company submitted the design the Government felt was most suitable, and the final decision on the engine was based primarily on an analysis of which engine was better adapted to the Boeing plane.[66]

January 1, 1967 to the Present. On January 1, 1967, contracts were drawn between GE and the FAA for development of a prototype engine for the SST, and between Boeing and the FAA for development of a prototype airframe. Consistent with its earlier statements that it would assure engine noise levels for the plane that would be "socially acceptable," the FAA insisted that noise standards be included in the contracts. Accordingly, the approach and airport noise levels specified in the Boeing contract are approximately equal to levels produced by subsonic jets, while the take-off level is lower.[67]

These standards are *production objectives* rather than inflexible requirements for the prototype planes Boeing has contracted to construct. The FAA explains that while they expect Boeing to be able to "come close" to these numbers, neither the Agency nor Boeing guarantees that strict compliance is possible.[68] Publicly, Transportation Secretary Alan Boyd is confident that the standards will be met. In May, 1967, he told Congress that "These engines have such tremendous power that at subsonic flight they will be able to operate with less noise than the existing subsonics that are utilizing maximum power."[69] Privately, FAA officials are much more cautious, prefering to abide by their earlier statements that they expect the SST engine noise levels to be at least equal to those of subsonic jets.[70] Some state that "there is a real aggres-

63. *Id.*
64. FAA, Request for Proposals for the Development of a Commercial Supersonic Transport 20 (Aug. 15, 1963).
65. Interviews with officials of the FAA.
66. *Id.*
67. FAA contract no. FA-SS-67-3, at A-7 (Jan. 1, 1967).
8. Interviews, *supra* note 65.
. *Hearings on Dep't of Transportation Appropriations*, *supra* note 52, at 37.
0. Interviews, *supra* note 65.

sive" noise reduction program at Boeing and GE which encourages them to believe that "we can keep the noise to today's levels, although it will be tough, because the engines have to be bigger."[71] Others are more sceptical.[72]

At this stage, the assessment process for the engine problems is carried out jointly by the contracting companies and the FAA. GE and Boeing submit quarterly progress reports to the FAA's Supersonic Transport Project Office. In addition, the companies and the Agency exchange information informally, since close contacts between them have developed in the course of the administration of the contracts.

The Assessment Process Evaluated

Since the supersonic transport prototype models probably will not be ready until 1971 or 1972, a complete evaluation of the efforts of the Government and the contractors to predict and control the engine noise levels is not possible. But some interesting conclusions can be drawn from the assessment process that has taken place so far.

1. The congressional hearings in 1960 demonstrated that Congress and the FAA have been aware of the potential problems of the SST engine noise levels from the beginning of serious discussions about the federal government's role in the design and construction of the plane. Other government agencies which participated in early decisions regarding the SST, such as NASA, the Department of Defense, and the Office of Science and Technology, have also shown an understanding of the noise levels likely to be produced by the plane and of the need to take some steps to reduce these levels. In addition, the airline industry has repeatedly made known to the FAA and Congress its recognition of the noise issue.[73]

Thus some of the social consequences of using advanced technology to produce the new, more powerful engines required for a supersonic commercial airliner were anticipated several years prior to the announcement by President Kennedy that the Government would support development of the plane. The institutions and processes which led to this anticipation were both formal and informal. Congressional hearings, advisory committees and the regular research of government agencies and industry produced a general recognition among some members of Congress and presidential advisors of the engine

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71. *Id.*

72. *Id.* On May 1, 1968, the New York Times reported that the Boeing Company was considering switching to a fixed-wing concept in order to overcome difficulties being encountered in design of the plane. If the fixed-wing design is eventually adopted, it is likely that the engine noise problems created by the plane will be increased. *Hearings on U.S. Commercial Supersonic Aircraft Development Program*, *supra* note 60, at 162 (remarks of Gordon Bain, Deputy Administrator, Supersonic Transport Development, FAA).

73. *Hearings on U.S. Commercial Supersonic Aircraft Development Program*, *supra* note 60, at 449.

noise problem. No institutions specifically devoted to technology assessment were necessary to bring about this awareness.

2. However, as was apparent in the case of weather modification, the assessment process has had limitations that are primarily a result of the fact that the major participants in the engine noise assessment process—the FAA, the airplane and engine manufacturers, other government agencies such as NASA and DOD—for over five years have had vested interests in the successful design and construction of the SST.[74]

While the FAA has consistently raised the question of how to build an SST that will not significantly increase the amount of jet noise to which communities surrounding airports are now exposed, it has not seriously considered, in connection with the SST program, a more searching question: How much noise from jets should the Government tolerate, and what can be done to reduce SST jet noise to that level? Approaching the task of setting standards for engine noise with the primary goal of reducing noise below the level of public tolerance might have produced contract "Production Airplane Objectives" significantly more stringent than those in the Boeing contract now, because, according to the FAA, many people living near airports find jet noise intolerable as soon as the levels approach 85-90 Pndb.[75]

The major reason why the FAA and other groups involved in assessment of the engine noise problem have concentrated instead on constructing a plane which would not generate noise levels above those of subsonic jets is that they have assumed that certain other characteristics of the SST should not be altered. As one FAA official explains, "Given a plane with a range of 4,000 miles, a speed of 2.7 mach, a payload of 60,000 pounds, operating off existing runways, the contract objectives are the lowest possible noise level expectations. If you start by setting noise figures which would eliminate complaints about noise, you might end up with a very different kind of plane, one that would not fit our conception of the SST."[76] Another official describes the process of choosing noise standards this way: "Start with the kind of plane you need, then drive the numbers as low as you can possibly get them."[77] Thus, because the individuals and institutions assessing the noise problem have been committed to development of the SST commercial plane with the characteristics described above, the assessment process has been limited. Efforts to reduce the noise levels have concentrated on comparing engine noise with noise from existing subsonic jets rather than on the noise level people living near airports find tolerable.

Although the FAA and the airplane industry have admitted for several years that the noise on the runway and at the airport from the SST will probably be greater than from subsonic jets, no comprehensive studies have been made of the costs of soundproofing airport buildings or expanding airport

74. *See, e.g., Hearings on Independent Offices Appropriations for Fiscal Year 1962 Before a Subcomm. of the Senate Comm. on Appropriations*, 87th Cong., 1st Sess. (1961).
75. Interviews, *supra* note 65.
76. *Id.*
77. *Id.*

boundaries. In 1963 E. Thomas Burnard, Executive Director of the Airport Operators Council, which represents local government bodies that maintain and operate airports, warned the FAA that the noise levels at the airport might require such expenditures. Burnard told the Senate Commerce Committee:

> [W]e don't think that these economic considerations should overlook the possibility of buying thousands of acres of prime real estate in major metropolitan areas, should the noise calculations be off, or millions of dollars of concrete should the aircraft be incapable of operating off the existing—or currently planned—runways. . . . Aircraft that require further soundproofing of terminal buildings, concourses, fingers, maintenance and operating areas, and even mobile lounges, will also add to the cost of operation.[78]

The FAA says that "not a lot" of money will have to be spent on improved soundproofing or airport expansion, but does not know "exactly how much we might have to pay."[79] Such computations have not been made because compared with the total cost of the multi-billion dollar SST program, these sums are likely to be small. Those committed to development of the plane therefore tend to regard Burnard's warning as relatively insignificant, even though a thorough assessment of the costs and benefits of the engines for the SST would require some quantitative estimates of these costs.

In the design competition between GE and Pratt-Whitney, the FAA and the advisory committees evaluating the competing designs did not make a direct comparison of the noise levels likely to be produced by the two engines because their basic aim was to choose an airframe with the qualities and dimensions they sought, and then to pick the engine best suited to the frame. FAA officials acknowledge that the design competition could have been arranged in a manner that would have permitted noise level comparisons to be made. But commitments to a particular kind of plane limited the structure of the competition.

Fluoridation

Probably no issue of science and public policy has involved as much emotional fervor as fluoridation. Over 900 referenda on fluoridation have been held in the United States since 1950,[80] and nearly every one has taken place in an atmosphere filled with irrational charges and counter-charges. Almost 20 years after the major American dental and medical organizations accepted fluoridation, public health officials in such cities as New York, Detroit, and Los Angeles are still faced with strong, articulate opposition to it.

78. *Hearings on U.S. Commercial Supersonic Aircraft Development Program*, *supra* note 60, at 392.
79. Interviews, *supra* note 65.
80. U.S. Public Health Service, Fluoridation Census 342 (3d ed. 1966).

Decay-resisting effects of chemical compounds of fluorides were discovered in the 1930's,[81] and by 1940 some scientists and public health officials were urging local communities to add fluorides to their drinking water supplies.[82] But not until the United States Public Health Service endorsed fluoridation as a safe, effective method of combating tooth decay in 1950 did many towns adopt it.

Early Warnings

In 1944, the Federal Security Agency held hearings[83] to determine what tolerances should be set for fluoride residues from spraying agricultural products. In the course of the hearings, the possibility of adding fluorides to public water supplies was also debated. H. Trendley Dean of the Public Health Service, who had been in charge of PHS studies of fluorides and dental health since the early 1930's, testified that he had already begun investigations of the effects of fluorides occurring *naturally* in water supplies of many towns in the Southwest to find out what fluoride levels were potentially harmful. Dean told the hearing that water containing 8 parts per million (ppm) fluoride in Bartlett, Texas, produced several minor changes in bone structure, nails, pelvis and the lumbar spine, but that these were "a matter of small importance as to public health."[84] Dean added that hundreds of thousands of people had been drinking *naturally* fluoridated water for many years in this country and that the PHS had no reports of fluoride poisoning. Thus the PHS was considering the possibility that *artificially* fluoridated water, containing about 1 ppm fluoride might be a method of combating tooth decay that would not result in any ill effects.

Some other scientists testifying at the 1944 hearings were more sceptical about the consequences of fluoridating water. A University of Chicago physiologist pointed out that physical harm would often be difficult to detect. "You have to do tremendous damage, because of compensatory repair," he said, "before you can get evidence of injury. However, the injury process undoubtedly goes on."[85] Others testified that statistical epidemiological surveys such as the ones the PHS conducted in the Southwest might be misleading, since people would react differently to fluorides, just as they would react differently to any drug. A third witness warned against analogizing experience with natural fluoridation to artificial fluoridation. He noted that other minerals in the naturally fluoridated water could reduce the likelihood of harm by combining with the fluorides to form compounds that pass through the body instead of being deposited in the bone structure.

PHS Caution and Pressure from Wisconsin

Despite their general belief that artificial fluoridation at the 1 ppm level probably would be completely safe, PHS officials in the early 1940's were unwilling

81. McNeill, The Fight for Fluoridation (1957).
82. *Id.*
83. Federal Security Agency, Docket No. FDC-41 (1944).
84. *Id.* at 449-54.
85. *Id.*

to recommend that communities began adding fluorides to drinking water. They felt that within a few years more conclusive results of research would provide them with an even stronger case for fluoridation, and would answer any remaining questions about physical or dental effects. In particular, the PHS in 1945 began two experimental projects in conjunction with state public health officers in New York and Michigan. In each state two cities were chosen, one to be fluoridated artificially, and the other to serve as a control. The experiments were designed to last ten years; then the PHS would reevaluate its position on fluoridation.

Energetic public health officers in Wisconsin, however, were not willing to wait for this research to be completed. They were actively engaged in a campaign to bring about an early PHS endorsement of fluoridation. Since 1941 Wisconsin cities had been accepting it, primarily as a result of the persuasive efforts of the state dental society and two of its members, Dr. Francis A. Bull of the state Board of Health and Dr. John Frisch, a Madison dentist. After the PHS demonstration projects in New York and Michigan were under way, Frisch and Bull launched a remarkably intense nationwide effort to obtain a PHS endorsement of fluoridation before the ten year period passed.[86] They criss-crossed the country attempting to persuade dentists and community leaders of the benefits of fluoridation.[87]

By 1950 Frisch and Bull were beginning to reap results. Early data from the Michigan demonstration project were leaking out through the University of Michigan Dental School, which supervised the project. Figures revealed definite reductions in the incidence of tooth decay. Frisch publicized these statistics, and argued that now the benefits of artificial fluoridation had been proved. Any delay in introducing mass fluoridation, he contended, would no longer be justified. Privately, Frisch and Bull told the Public Health Service that they had better get on the fluoridation band wagon if they did not want their image as leaders in public health to be permanently tarnished.

In addition, by 1950 influential state dental health officers were taking positions in favor of fluoridation. On May 8, David Ast, New York's director of dental health, sent a memo to his regional health directors offering state aid to local communities wishing to start fluoridation.[88]

The Endorsement

The climax of the mounting pressure for fluoridation came in late May, 1950, at the annual meeting of state and territorial dental health officers in Washing-

86. This campaign has been recorded in the F.S. McKay and John Frisch Papers of the Wisconsin State Historical Society, Madison, Wisconsin.

87. Herbert Bain, an official of the American Dental Association, came to dread meetings "because those guys would show up and never let you off the hook." Interview with Donald R. McNeill, in Madison, Wisc., Dec. 23, 1966.

88. Memorandum from David Ast, May 8, 1950, in McKay Papers, *supra* note 86.

ton. Dr. Bull once again buttonholed every major Public Health Service official attending the conference. In particular, he concentrated on Dr. Bruce Forsyth, assistant surgeon general and chief dental officer for the PHS. Bull drew Forsyth aside and told him he was "being made a sap out of,"[89] because before long the PHS would be the only major health organization refusing to endorse fluoridation. Forsyth agreed to attend a private meeting of four state dental directors, plus Dr. H. Trendley Dean and Dean's assistant, Dr. Francis Arnold. The four directors were Bull, David Ast of New York, Edward Taylor of Texas and Robert Downs of Colorado, who had briefed each other carefully in preparation for the encounter with Forsyth, Dean and Arnold.

At the meeting Dean argued that since the New York and Michigan studies were only half completed, it was still not time for the PHS to take a position. When several days passed without the PHS endorsing fluoridation, Bull assumed that Dean's view had prevailed. Within the PHS, however, the debate was still going on. Although Dean stuck to his original position, Forsyth and Surgeon General Leonard Scheele were becoming convinced that it was time for the PHS to back fluoridation. Finally, Forsyth and Scheele, as the nation's top-ranking public health officers, either formally overruled Dean or informed him that they were about to endorse fluoridaton, with or without him. On June 1, 1950, came the announcement from the PHS that "Communities desiring to fluoridate their communal water supplies should be strongly encouraged to do so."[90]

The Delaney Hearings

There was a strong feeling in the Public Health Service in 1950 that because of the prevalence of tooth decay among children and adults in the United States, public health measures should be taken as quickly as possible to reduce the incidence of decay. The PHS believed that the experience with naturally fluoridated water supplies, plus the preliminary results of the Michigan and New York studies, justified its conclusion that fluoridation was a safe, effective answer to the problem. Eighteen months later, however, at hearings on chemicals in foods and cosmetics, conducted by the House Select Committee to Investigate the Use of Chemicals in Food Products,[91] evidence was presented which indicated that a number of questions had not been thoroughly explored by the PHS before its endorsement of fluoridation. For instance, while physical examinations were performed on children in the Michigan and New York projects in order to detect possible adverse effects of artificial fluoridation, no such examinations were performed on adults in the selected communities. Other points overlooked by the PHS and brought out at the hearings included:

1. Dr. John Knudson of the PHS admitted that the studies had never spe-

89. Interview with Dr. Francis Bull by Donald R. McNeill, Apr. 26, 1955, in McKay Papers, *supra* note 86.

90. Am. Dental Ass'n Newsletter, June 1, 1950.

91. *Hearings on Chemicals in Foods and Cosmetics Before the House Select Comm. to Investigate the Use of Chemicals in Food Products*, 82d Cong., 2d Sess. (1952) [hereinafter cited as *Hearings on Chemicals in Foods and Cosmetics*].

cifically gone into the question of the possible effect of the addition of artificial fluorides to water on children who are suffering from malnutrition.[92] Yet, the February, 1952, issue of the Journal of the American Dental Association had warned that "low levels of fluoride ingestion which are generally considered to be safe for the general population may not be safe for mal-nourished infants and children, because of disturbances in Calcium metabolism."[93]

2. Dr. Isador Zipkin of the PHS admitted that although they had performed chronic toxicity studies of the effects of fluoride on rats, a procedure recognized by a number of authorities as necessary before any chemicals are inserted in a food product, such tests were not completed until at least a year after the PHS formally endorsed fluoridation.[94]

3. The PHS went ahead with its endorsement although a June, 1950, report on the New York demonstration project concluded that "a longer period of observation is required before final conclusions can be drawn. The possibility of demonstrating cumulative effects of fluoride in the final years of the ten year study cannot be eliminated at this time."[95]

4. The possibility of carcinogenic characteristics of fluorides was not investigated by the PHS.[96]

5. Congressman A. L. Miller asked a representative of the National Cancer Institutes if any experiments had been or now were "being carried on as to ill effects in pregnant women and in people with chronic diseases, that is the older people . . . ?" The NCI official said he knew of none. Dr. Trendley Dean of the PHS added: "I don't know of any experiments being conducted along that line."[97]

6. No attention was given to legal questions which might be raised by fluoridation. The possibility that some individuals might consider fluoridation of water as a violation of their civil liberties, or that some religious groups might oppose fluoridation as an abridgement of their first amendment rights, apparently played no role in the PHS decision.

On the basis of this evidence, the Select Committee concluded that

> a sufficient number of unanswered questions concerning the safety of this program exists as to warrant a conservative attitude. The committee believes that if communities are to make a mistake in reaching a decision on whether to fluoridate their public drinking water, it is preferable to err on the side of caution . . . since there are reasonable alternatives to fluoridating the public water supply, even if these alternatives are not quite as effective. The topical application of fluorides to the teeth of children may be more cumbersome, and

92. *Id.* at 1510.
93. J. Am. Dental Ass'n, Feb., 1952.
94. *Hearings on Chemicals in Foods and Cosmetics, supra* note 91, at 1659.
95. *Id.* at 1508.
96. *Id.* at 1493.
97. *Id.* at 1668.

perhaps more expensive, than the simple addition of fluorine to drinking water. Nevertheless, it is a feasible program, and one which will provide comparable protection for children's teeth for the period needed to acquire evidence beyond a reasonable doubt that no hazard exists to any portion of the population by reason of the addition of fluorides to drinking water.[98]

The committee strongly urged that research be continued "to determine the long-range effects upon the aged and chronically ill of the ingestion of water containing inorganic fluorides."[99] Thus, the committee in effect said that the Public Health Service had issued a premature endorsement of fluoridation as a completely safe public health measure.

Why did the PHS give its unqualified support to fluoridation before several important medical and legal issues had been thoroughly explored? There are two basic reasons. First, the campaign directed by Drs. Frisch and Bull succeeded in generating significant pressure in dental and public health circles for fluoridation. Because of their general concern about public health issues, and particularly the problem of tooth decay, the officials responsible for PHS policy with respect to fluoridation, Surgeon General Scheele, Dr. Bruce Forsyth and Dr. Dean, were receptive to the growing demand for active support of fluoridation.

Second, the Public Health Service was not as likely to be as sceptical in its investigation of the effects of a chemical or drug as an agency such as the Food and Drug Administration, whose primary mission is to test for safety of chemicals and drugs. Since its creation in 1798, the PHS has been entrusted with the responsibility for *introducing* new concepts in public health and for *promoting* public health measures. Its main emphasis, therefore, has been on the prospective *benefits* of scientific research, and this was clearly revealed in its fluoridation studies of the 1940's. The experimental projects begun in 1945 in New York and Michigan had as their real purpose the investigation of whether artificial fluoridation would have the same anticariogenic effects observed in naturally fluoridated areas.[100] Thus, while thorough physical and dental examinations were performed on children in the selected communities, adults were ignored because the PHS knew from its previous research that the benefits of fluoridation would only be observed in children. The PHS was aware of and concerned about possible adverse medical consequences of fluoridation, but its primary interest in confirming the benefits of fluoridation easily created a situation in which the issues brought out by the Select Committee in 1952 were not rigorously researched, particularly when the limited studies undertaken in naturally fluoridated areas had not yielded cases of serious physical harm.

The dual responsibility to produce a cure for tooth decay and to test its safety placed the PHS in a very difficult position during the early struggles over

98. Select Comm. to Investigate the Use of Chemicals in Food Products, Report on Investigation of the Use of Chemicals in Foods and Cosmetics, H.R. Rep. No. 74, 82d Cong., 2d Sess. (1952).
99. *Id.*
100. *Hearings on Chemicals in Foods and Cosmetics, supra* note 91, at 1-64 (remarks of Dr. Francis F. Heyroth, Nat'l Research Council's Ad Hoc Comm. on Fluoridation).

fluoridation in the 1940's. Suppose that the Food and Drug Administration were charged not only with testing the safety of drugs, but with inventing and developing drugs which the medical profession depends upon to perform its responsibilities. The FDA would often be faced with a basic conflict of roles that would undoubtedly limit its ability to assess the impact of drugs thoroughly and objectively. Likewise, the PHS in the case of fluoridation was hampered in its assessment functions by the need to perfect, as quickly as possible, a method of eliminating tooth decay. The result was that while some questions concerning the safety of fluoridation were answered before the PHS endorsement, others, primarily questions of long-term effects, were not.

The PHS and Assessment of Fluoridation Since 1950

The assessment process for fluoridation which the Public Health Service has followed in the past 18 years is both symbolic and significant. The task of continuing assessment has been complicated by the irrational charges and attacks that have come from many opponents of fluoridation. Appeals to fear characterize the speeches and pamphlets frequently used by antifluoridationists to persuade people to oppose fluoridation. These tactics have lessened the likelihood that more rational critiques of fluoridation will be evaluated objectively and have given the PHS the added burden of distinguishing between reasonable and ridiculous criticism.

After the PHS announced its support of fluoridation, the American Dental Association, the American Medical Association, and other major scientific and health organizations soon moved to endorse it, using PHS studies and research as the bases for their conclusions. The PHS announcement also spurred the introduction of fluoridation in numerous parts of the country. One year before the PHS endorsed fluoridation, one million Americans were drinking fluoridated water. A year after the endorsement, five million were drinking it.

Once the decision to endorse fluoridation was made, the PHS became actively involved in its promotion. The tone of PHS support was set in June, 1951, at the Fourth Annual Conference of State Dental Directors with the PHS and the Children's Bureau in Washington. PHS spokesmen outlined a program designed to persuade city officials, doctors, dentists and laymen to begin fluoridating their water supplies. Descriptions were given about how to allay people's fears about fluoridation: "[N]ever use the term artificial fluoridation; there is something about that term that means a phony. We call it 'controlled fluoridation.'" An organizational framework for a fluoridation campaign was suggested: "You come out with a resolution from your county or local medical organization. You do the same thing with your local board of health. In many places the next thing to do is to go before lay groups, service clubs, PTA's, and always invite the public officials, watermen, aldermen, mayors, anybody you can get." And a strategy was recommended: "If you can, . . . keep

fluoridation from going to a referendum."[101] Since this conference, the PHS has continued to be a major promoter of fluoridation, through preparation and distribution of materials, storage of information and education of doctors, dentists and local public health officials.

At the same time, the PHS has experimented on the medical and dental effects of fluoridation.[102] The ten year projects in New York and Michigan were completed, and various analyses were made of people who had been drinking naturally fluoridated water all their lives. No serious physical defects were observed. Reports of adverse physical effects of fluoridation do appear periodically, however, in the scientific literature,[103] and although most scientists as well as doctors and dentists seem to accept the PHS verdict on fluoridation, there is disagreement. A number of prominent scientists have argued that more ought to be known about the long-term consequences of drinking fluoridated water before people drink it daily.[104] In Europe, while British public health officials have endorsed fluoridation enthusiastically, the Danish government has prohibited it, and Swedish cities have only recently begun to introduce it.

PHS officials have expressed their willingness to evaluate studies critical of fluoridation carefully and objectively, but the ability of the PHS to offer a balanced assessment is limited by the strong public commitment to fluoridation it has voiced since 1950. Two particular kinds of limitations have been noticeable.

1. The agency has not investigated as thoroughly as possible the results of research that might cast doubt on the wisdom of PHS support of fluoridation. For instance, an important element in the case developed by the PHS in 1950 for the safety of fluoridation was the calculation of a normal adult's daily total intake of fluoride, compared with the daily intake that might possibly lead to harmful results. PHS scientists told the Delaney committee that their studies had shown that an adult living in a fluoridated community ordinarily consumed about 1.3 mg of fluoride each day.[105] Since other PHS research indicated that 4-5 mg "may be the limits of fluorine which may be ingested daily without an appreciable hazard,"[106] the agency concluded that fluoridation contained an acceptable safety factor. In 1966, however, scientists at the National Research Council of Canada published a study[107] indicating that the individ-

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101. Proceedings, Fourth Annual Conference of State Dental Directors with the Public Health Service and the Children's Bureau 11, 18, 22 (1951).

102. For reports of these experiments, see PHS, Fluoride Drinking Waters, PHS Document No. 825 (McClure ed. 1962) [hereinafter cited as Fluoride Drinking Waters].

103. For a review of these reports, see Burgstahler, Dental and Medical Aspects of Fluoridated Drinking Water, 68 Transactions of the Kansas Academy of Science 223 (1965) [hereinafter cited as Burgstahler].

104. E.g., Dr. Hugo Thorell, Swedish Nobel Prize-winning enzyme chemist, Dr. Simon A. Beisler, Chief of Urology at Roosevelt Hospital, New York City, and Dr. Ludwik Gross, Chief of Cancer Research, Veterans Hospital, New York City. A recent survey conducted by the author also indicates that many scientists who endorse fluoridation believe that more research should be conducted on possible adverse effects.

105. *Hearings on Chemicals in Foods and Cosmetics*, *supra* note 91, at 1643.

106. Fluoride Drinking Waters, *supra* note 102, at 383.

107. Marier & Rose, The Fluoride Content of Some Foods and Beverages—A Brief Survey Using a Modified Zr-SPADNS Method, J. of Food Science, Nov.-Dec., 1966, at 941.

ual's total intake of fluoride in a fluoridated community will now vary from 2 to 5 mg. Laborers who work outdoors in hot weather "undoubtedly" will get more than 5 mg, the authors said, because they drink much more water. The increased levels were attributed to changes in recent years in the amounts of fluorides in foods and beverages which are part of a normal diet.

Instead of sponsoring further studies to confirm or deny the Canadian reports, the PHS responded by dismissing them rather disdainfully. Fluoridation, agency officials said, has been proved completely safe, and no additional studies are now necessary. One PHS scientist argued that the Canadian studies could not be taken seriously because one of the authors "does not have a Ph.D."[108]

2. The PHS also has adopted an aggressively defensive attitude toward critics of fluoridation, which tends to discourage meaningful exchanges of views on the subject. For instance, Public Health Service scientists have refused to publicly discuss or debate with scientists who are critical of fluoridation the scientific merits of the PHS position. The PHS argues that such discussions "would serve no useful purpose,"[109] since fluoridation has been proved completely safe. The scientific community does not unanimously agree.[110]

Moreover, the PHS attitude has occasionally led it to take action fostering a charged atmosphere in which objective evaluation of fluoridation is difficult. For example, when the American Society for Fluoride Research held its first meeting in September, 1966, several well-known antifluoridationists were openly associated with the group. Although presentations were made by pro-fluoridationists, antifluoridationists and scientists not committed to either view, the PHS feared that the conference might receive publicity which would influence an impending referendum in Detroit on fluoridation. PHS therefore successfully urged the American Dental Association headquarters in Chicago and Detroit to release a statement charging that the ASFR "is only a sounding board for fluoride opponents."[111] The *Detroit News* picked up the release and ran a front page story with the headline "Research Talk Called Plot Against Fluoridation."[112]

The PHS took similar steps in the fall of 1967 with respect to an organization called the International Society for the Study of Nutrition and Vital Substances, a European-based group that passed a resolution opposing fluoridation.[113] When several American opponents of fluoridation learned of the So-

108. Interview with Public Health Service scientists.
109. *Id.*
110. Burgstahler, *supra* note 103; note 104, *supra*.
111. Detroit News, Sept. 25, 1966, at 1.
112. *Id.*
113. Resolution 39, International Society for Research on Nutrition and Vital Substances, Hanover, Germany, Sept., 1966.

ciety's resolution, they formed a committee to distribute it in this country. The PHS, learning of the American committee's activities, hastily issued a statement claiming that American antifluoridationists had infiltrated an international society, pushed through a resolution condemning fluoridation and were now using it for their own purposes in the United States. Later the PHS learned that the American committee was formed long after the resolution had been passed, and that none of the committee members had anything to do with the drafting or passage of the resolution, and therefore issued a revised statement. Nevertheless, this case and the case of the ASFR indicate that the strength of its commitment to fluoridation can prompt the PHS to take hasty action that compromises its ability to provide a detached, comprehensive assessment of comments and research on fluoridation.

Conclusion

These three case studies indicate that the federal government's vested interests in the continuation of its technological programs limit its ability to provide adequate technology assessment. In the field of weather modification, agencies are reluctant to explore in depth the need for regulation of their own operational programs. In the SST project, the Federal Aviation Agency has been unable to ask the kinds of questions about engine noise that might challenge basic assumptions about the plane the agency is developing. In the case of fluoridation, the Public Health Service's advocacy has interfered with its responsibility for continuing assessment of its original endorsement.

The deficiencies in technology assessment for these particular programs fortunately have probably not yet resulted in serious damage to the public or the environment. The pace of technological development through government sponsored projects, however, continues to expand. Concurrently, as Professor Harold P. Green of the George Washington University National Law Center points out,

> Technological advances carry with them the very real threat of destruction of human beings and cherished human values. How much damage could a single demented or evil person have inflicted on society in a single act 25 years ago? Today, such a person in a single act may have the capability of inflicting upon society immense damage measured in thousands, if not millions, of human lives.[114]

Two recently publicized examples reveal the appropriateness of Green's description of the potential dangers of technology. In Utah, 6,000 sheep have been killed in circumstances which strongly suggest that their deaths were the unplanned consequence of chemical warfare tests conducted by the Army.[115] In Colorado, the disposal by the Government of huge amounts of radioactive wastes has apparently created a possibility that an earthquake may inflict

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114. Green, The New Technological Era: A View From the Law, Monograph No. 1, Program of Policy Studies in Science and Technology, Geo. Wash. Univ., Jan., 1966, at 2.
115. N.Y. Times, Mar. 27, 1968, at 46.

serious damage on the city of Denver in the near future.[116] The fact that such situations do occur, coupled with increased government involvement in technological development, means that if the existing processes for technology assessment are allowed to continue unchanged, they may become entrenched patterns of decision-making which, although designed to confer the benefits of science and technology upon society, in fact pose grave threats to the health and safety of our physical and social environment.

Congressman Daddario has suggested that creation of a Technology Assessment Board would help Congress perform its technology assessment functions more effectively by making available more information on the range of consequences of specific applications of science and technology.[117] The Board would identify issues and provide Congress with a "balanced appraisal" of the costs and benefits of projected programs. Undoubtedly, some such mechanism would enable members of Congress to anticipate potential hazards more often, and to debate issues of science policy more fully before vast amounts of government money are committed to mission-oriented programs.

But the results of the case studies examined here imply that an institution designed to educate the Congress will probably not confront some of the basic weaknesses in technology assessment today. The studies indicate that the federal government is often aware of many of the implications of its programs in science and technology, but that it should not be relied upon for thorough evaluation and regulation of the technologies it sponsors. What is needed to complement the Government's own assessments is a way to counteract the natural tendency of the government to resist rigorous and comprehensive technology assessment. But how should this function be performed, and who should perform it? Two suggestions may be helpful in answering these questions:

1. Private groups, operating outside the framework of government, might be able to persuade it to place more emphasis on reduction and elimination of potential hazards of technology. One such organization has in the past ten years acquired the respect of many scientists and politicians throughout the country. In 1958, a number of scientists, university professors and other citizens in the St. Louis area who were concerned about the effects of radioactive fallout formed the Committee for Nuclear Information (now the Committee for Environmental Information), which has gathered information on pollution and radiation hazards, performed scientific studies of potential hazards and circulated information to the Government, the public and the scientific community. Through a monthly magazine, *Scientist and Citizen*, and occasional testimony before congressional committees, CEI has generated a great deal

116. *Id.*
117. Daddario Statement, *supra* note 1, at 3.

of interest in problems of environmental pollution. It has demonstrated that private independent organizations can perform useful assessment functions.

Other groups, particularly within universities, could perform similar functions in the area of science and public policy. There are, however, major problems which private technology assessment institutions must overcome if they are to have any impact on government programs. First, they must have competent, reputable staffs that are respected by government and the rest of the scientific community even when they take unpopular positions on issues. Second, they must find adequate funding. Finally, they must face the fact that frequently important information on the structure and operation of government programs is inaccessible unless the staff has an open channel of communication with officials in charge of the programs.

2. Within government, steps could also be taken to tackle the problem of providing thorough assessment of government-sponsored programs that may involve technologically created hazards. Congress could, for instance, establish a *Technological Hazards Board, authorized by statute to appear before Congress and the agencies solely as a lobbyist for reduction and control of potential risks to the public and the environment.* A staff of energetic, knowledgeable public servants could survey government programs, inform sponsoring agencies, Congress and the public of potential hazards, and discuss with Congress and the agencies ways of eliminating them. Since it would lobby, the THB's functions would be much broader than those of Congressman Daddario's Technology Assessment Board. Moreover, because sponsoring agencies can, as we have seen, be counted upon to publicize and emphasize the potential benefits of their programs, the Technological Hazards Board would concentrate on identification and control of potential risks. In short, the THB would perform a technological audit of government programs, without having legislative powers or ultimate authority for regulating the conduct of these programs.

The contribution to technology assessment that a Technological Hazards Board could make can be illustrated with respect to each of the technological programs we have previously examined. Since the Board would not have vested interests in weather modification, it would be able to press Congress and the relevant executive departments for action on the recommendations made by the Newell Report, the NAS Panel and the NSF Special Commission for a regulatory structure. The Board could have asked the kinds of questions about engine noise of the SST that the FAA did not ask. And because it has not been promoting fluoridation for the past 18 years, the Board would be in a position to provide an objective assessment of continuing research on fluoridation or to ask the Food and Drug Administration to undertake a thorough investigation.

Because ultimate authority for direction of government programs would remain with the Congress and the agencies, the THB would not be in a position to stifle necessary scientific and technological progress through its single-minded concern for potential hazards. Its efforts would, instead, operate as checks against the tendencies of sponsoring agencies not to engage in compre-

hensive technology assessment. The existence of the Technological Hazards Board would, in effect, institutionalize a system of checks and balances on issues of science policy formulation, thereby assuring a more rational, more thorough assessment of individual government programs.

Many questions about a Technological Hazards Board would have to be answered before it could be accepted by Congress. How to assure its independence, or to define the scope of its activities—these and other issues would require careful analysis. But the idea of creating an institution, like the THB, that would *persuasively and persistently* inject the need for eliminating hazards into every government decision regarding applications of science and technology should be seriously discussed. Perhaps the basic lesson to be learned from the cases we have observed is that such an institution is urgently required.

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V. CASE STUDIES

C. Consideration of Environmental Noise Effects in Transportation Planning by Governmental Entities

Louis H. MAYO

December 1972, pp. 1-53

I - Advancing Technology and Social Values

In the evolving context of governmental planning or efforts to initiate governmental planning of transportation systems, considerations of environmental noise have made very recent entry into the process. We have generally been concerned with the primary, direct, and immediate objectives of providing more or new transportation services than with adverse side-effects such as congestion, air pollution, noise intrusion, and aesthetic debasement.

Planning of a "complete" national transportation network was carried out in our early history. This scheme, though never enacted, was put forward in 1824 by the Corps of Topographical Engineers under the War Department. Professor A. Hunter Dupree states in Science in the Federal Government (1957):

> Despite constitutional scruples, the Congress increasingly appropriated money for roads and harbor improvements. One offshoot of Monroe's straddling position on the constitutionality of internal improvements was the Survey Act of 1824, under which the Corps of Topographical Engineers made a comprehensive plan for canals between the Chesapeake and the Ohio, along the Atlantic seaboard, and for a road from Washington to New Orleans. This plan, the only one the government ever attempted to make for the country as a whole, required considerable technical competence, and had it been executed would have required even more. (p.36)

In his first annual message to Congress of December 6, 1825, President John Quincy Adams referred to the "internal improvement of the country" in the very first sentence and then continued:

> The great object of the institution of civil government is the improvement of the condition of those who are parties to the social compact, and no government, in whatever form constituted, can accomplish the lawful ends of its institution but in proportion as it improves the condition of those over whom it is established. Roads and canals, by multiplying and facilitating the communications and intercourse between distant regions and multitudes of men, are among the most important means of improvement.[1]

Professor Richard B. Morris in Great Presidential Decisions (1960) states in reference to President Adams' proposal that:

> (T)he measures of his administration were "just and wise and every honest man should have supported them," but many did not because they simply could not abide their author, and still others because they were frightened by his centralizing philosophy of government. (p.107)

Apart from President Adams' personality difficulties there were substantial political, economic, demographic, and technological reasons why a national road system was not considered an urgent matter. As Samuel Eliot Morison states:

> Watchers from afar can discern the shadow of things to come in 1826, midway in President Adams' term of office. The Erie Canal, completed the previous year, made New York the Empire State and New York

> City the world's most populous urban center. Yet the doom of the canal as a principal means of heavy transportation was sounded in 1826 by a little horse-drawn line, first railroad in the United States, built near the home of the Adamses in Quincy; and shortly the Baltimore & Ohio steam railway would be chartered.[2]

And to move further along in the last century:

> Canals still carried most of the freight in 1850, but the completion of the Hudson River Railroad from New York to Albany, where it connected with the New York Central for Buffalo, and of the Pennsylvania Railroad from Philadelphia to Pittsburgh, caused such an astounding transfer of freight from canals to railroads, particularly in the winter season, as to prove the superiority of rail for long-distance hauls, and to suggest that the locomotive was the proper instrument for penetrating the continent.[3]

Surely 1800 to 1900 was the century of coal and steam. The railroad was <u>the</u> means of transportation in that it fitted both the conditions and needs of this rapidly expanding nation even though canals continued in operation and steamboats found their use on the Mississippi and its tributaries. A new transportation era began to emerge about 1900, however. Professor Morison's lively tract on "The Auto and the Ad Man" provides the flavor as well as some interesting facts on this transitional period.[4]

During the last century the Federal government not only tended to encourage technological development, including transportation, as by means of land grants to the railroads. In some cases, the Federal government became directly involved. Support was lent to the "demonstration phase" of the development of the telegraph.[5] Support was also lent to certain research efforts. For example, between 1816 and 1848 "a total of 233 steamboat explosions had occurred in which 2,563 persons had been killed and 2,097 injured, with property losses in excess of $3 million." While it was not until 1852 that stringent and effective laws were enacted regulating boiler construction, operation and inspection, the Franklin Institute had researched the problem in 1836 and made recommendations at that time which embodied most of the recommendations finally adopted in Federal legislation of 1852.[6]

In general, we have followed the presumption of most Western notions, namely, that the impact of scientific inquiry and technological advance is socially beneficial. From Francis Bacon on we seem to have accepted the "science is good in itself" notion. Certainly the scientific approach, however superficial, pervaded the outlook of the philosophers of the Enlightenment, that high

point of belief in human rationality and the potential of man to perfect himself and society on earth. The Royal Society (chartered 1662) and similar organizations promoted the idea that "investment in science was an investment in prosperity."[7] Such organizations as the Lunar Society (1775-1791) were more "practical minded" and socially sensitive to the impact of science and technology than the more prestigious Royal Society.[8] Even the human wastage and misery inflicted by the early 19th century Industrial Revolution did not greatly diminish our infatuation with science and technology.

However, protests were made over the abuses of expanding industrialism supported by technological development. Consider the following quote from Elting E. Morison, Men, Machines and Modern Times (1966) in reference to Thomas Huxley:

> He came to Baltimore toward the end of the last century to say that he remained unimpressed by all the power, natural resources, knowledge and machinery that had so greatly extended man's competence over his physical environment. "The great issue," he went on, "about which hangs a true sublimity and the terror of overhanging fate is, what are you going to do with all these things?" (p.208)

Yet the prevailing attitude continued to encourage technological development. This was particularly true in America during the 19th century where resources were abundant, the population

was dispersed, transportation needs were critical and individual initiative was given the widest scope.

The industrialism supported by coal, steam and a burst of inventiveness, motivated by the excitement of "progress" and personal gain, reflected a social attitude raised to a Constitutional right through the doctrine of "freedom of contract."[9] Furthermore, numerous dedicated efforts to protect a broader and longer term concept of the "public interest" were blunted or defeated by the reluctance of the Federal government to encroach upon the traditional bounds of State "police power" over health, safety and general well-being.[10]

We have relied primarily on the "market" system for guiding and shaping the nature of new technological applications. There have been notable exceptions, however, as with the long agitation for improved public protection from adulterated foods and drugs which eventually resulted in the first Pure Food and Drug Act of 1906. But governmental regulation has, in general, been gradual and piecemeal and - as in the case of transportation - has usually evolved as a reaction to public demand for correction of specific and severe adverse effects of particular applications. The establishment of the Interstate Commerce Act of 1887 is an example.

As is well known, many of our more prominent technology-based regulatory agencies and statutory measures to control technological applications were not established until well into the 20th century. For the most part, these agencies represent reactive measures rather than prospective efforts to assure development of a new technology in the public interest. Even broadcasting was not brought under regulatory control until 1927 after frequency interference became intolerable. The development of nuclear energy represents perhaps the most outstanding example of new technology whose development began under government supervision and for which a reasonable well-ordered assessment structure has been maintained.[11]

Increasingly, since World War II, technological developments have been initiated and supported by the government or through combined government and industry efforts or government-university arrangements.

The strong emphasis on promotion of the direct and immediate benefits of advancing technology through the 19th and the first half of the 20th century does not mean, of course, that all segments of the affected public were in sympathy with this underlying social philosophy and most certainly not with some of its effects. In the mid-1800's many English

citizens protested vigorously over the noisy, smoky locomotives. Some landowners arranged for the intermittent firing of guns across their grounds to keep out railroad surveyors. "Parliament, exercising the right of eminent domain, eventually overcame these difficulties for the railroad companies, but only at a price: as a concession to objectors, a change was included in railway charters requiring that locomotives must not emit smoke."[12] Public reaction to large steam carriages "brought forth in 1865 the famous Red Flag Act which required a flagman on foot to precede each steam vehicle."[13] On the other hand, new technologies were sometimes applauded as the means by which more agreeable qualities might be introduced into the social environment. A quotation from Scientific American for July 1899 states:

> The improvement in city conditions by the general adoption of the motor car can hardly be overestimated. Streets clean, dustless, and odorless, with light rubber-tired vehicles moving swiftly and noiselessly over their smooth expanse, would eliminate a greater part of the nervousness, distraction, and strain of modern metropolitan life.[14]

II - The Constitutional Framework for the Allocation of Governmental Power with Respect to Transportation Systems Planning

Only in recent years has environmental noise gained sufficient attention as a social problem to generate assessments of the situation, proposals for comprehensive public programs of noise abatement, and enactment of a few innovative regulatory schemes. Various factors have forced the problem to the focus of public attention, as for example, the introduction of commercial jet-powered aircraft over the past 15 years and increasing vehicular traffic resulting from urbanization and further stimulated by the Interstate Highway System. The decibel level in various noise environments is definitely increasing. But there is more involved than this simple explanation of the growing concern with noise. This can be described as a rather drastic shift in social value priorities. This general concern, of which noise intrusion is but one element, is reflected in various statutory schemes enacted over the past several years of which the most prominent is the National Environmental Policy Act of 1969 which requires pursuant to §102(2)(C), the submission of environmental impact statements on "major Federal actions" and which established the Council on Environmental Quality.

The NEPA of 1969 and various other legislative schemes promoting environmental quality are indicative of the need for anticipatory project assessments, and hence, for more thoughtful planning of public and public/private programs in such fields as energy generation, law enforcement, health care services, and transportation. It is with respect to the initiation of various new transportation systems that public concern with the full scope of environmental values and amenities has, perhaps, been most manifest. Public protests have stalled the implementation of new airports or the modification of existing airport facilities. Numerous lawsuits have been instigated over the past few years which have had the effect of blocking new highway construction.

There is little question but that governmental entities at all levels have been somewhat tardy, if not delinquent, in giving adequate emphasis to the transportation systems planning process. The "planning function" for present purposes will be discussed in terms of the provision for and implementation of anticipatory assessments designed to take into account the effects of proposed transportation innovations on all participants and social value-institutional processes affected by given proposals. Particular attention will be focused on the extent to which environmental noise is given consideration as an adverse consequence in such assessments.

The abatement of environmental noise presents a severe challenge to legal-political improvisation as well as to technological ingenuity. The problem context of environmental noise is a complex one in that noise is not associated with one - or a few - social functions but is emitted from a vast variety of completely unrelated sources. Many of the most obnoxious noises come from moving sources or from multiple and diverse activities acting in concert. Hence, various techniques (abatement at the source, reduction of effects, or compensation for noise harm) have been devised in an attempt to cope with the multiplicity of sources and affected persons or activities. The noise abatement task is further complicated by the necessity to determine at what level of government these various techniques can best be prescribed and implemented.

It is sometimes said that noise is a "local problem," but this characterization can be a bit misleading. No doubt, noise is a "local problem" with respect to the Effects of noise. It is not necessarily a local problem with respect to the Control over the abatement of noise at the source or over the reduction of the magnitude of noise effects. The "noise context" selected for control purposes will ordinarily be defined in terms of the

noise effects emitted from particular discrete noise sources or identifiable noise environments.

What then is the basic legal-political framework within which the environmental noise problem must be analyzed? Environmental noise is primarily the result of a highly industrialized society. In a most thoughtful book of a few years back entitled Industrialism and Industrial Man (1960), the authors state:

> Pluralistic industrialism will never reach a final equilibrium. The contest between the forces of uniformity and for diversity will give it life and movement and change.
>
> The themes of uniformity and diversity, and manager and managed which mark the world today will characterize it in the future as well. There will be constant adjustments between these eternally conflicting themes, but no permanent settlement. They will constitute the everlasting threads of history: the uniformity that draws on technology and the diversity that draws on individuality; the authority that stems from the managers and the rebellions, however muted, that stem from the managed. (p. 296)

Our Constititutional development seems consistent with this formulation. For example, Art.I,§8(3) provides that the Congress shall have power "To regulate Commerce with foreign Nations, and among the several States, and with the Indian Tribes."

The 1824 Supreme Court case of Gibbons v. Ogden (9 Wheaton 1; 6 L.Ed. 23) gave impetus to the promotion of the "Commerce Clause" and interstate commerce by holding a New York law providing for a State "steamboat monopoly" invalid. The subsequent 1851 case of Cooley v. The Board of Wardens of the Port of Philadelphia (53 U.S. [12 How.] 299) has had great significance in terms of mediating between the themes of uniformity and diversity noted above. In that case the Supreme Court undertook to determine whether the power of the Congress to regulate foreign and interstate commerce was exclusive of whether it might be in part shared by the states. The Court adopted a rule which placed a segment of control in the states, the test being whether a particular subject or activity of commerce requires uniform national control or whether it is sufficiently local (and unique) in character to permit State regulation. For example, a strong national interest has been asserted in railway regulation. In Southern Pacific Co. v. Arizona (325 U.S. 761 [1945]) the Supreme Court, relying on the Cooley Doctrine held that the Arizona Train Limit Law (limiting train length) contravened the Commerce Clause, the majority opinion stating that "Here examination of all the relevant factors makes it plain that the state interest

is outweighed by the interest of the nation in an adequate, economical, efficient railway transportation service, which must prevail." But a strong State/local interest has been recognized in the regulation of the use of interstate as well as State highways. In South Carolina State Highway Department v. Barnwell Bros. (303 U.S. 177 [1938]), a State statute limiting the width and weight of motor trucks which was more restrictive than those of most other states was held not to be an undue burden on interstate commerce even though "interstate carriage by motor trucks has become a national industry," the Court stating: "Few subjects of state regulation are so peculiarly of local concern as is the use of state highways." But compare Bibb v. Navajo Freight Lines, Inc. (359 U.S. 520 [1959]), wherein the Supreme Court found an Illinois contour mudguard requirement for motor freight carriers to be in conflict with the Commerce Clause even though such "local safety measures" are normally not found to place an unconstitutional burden on interstate commerce.

The "states and their instrumentalities may act, in many areas of interstate commerce,...concurrently with the Federal government" and "Evenhanded local regulation to effectuate a legitimate local public interest is valid unless preempted by Federal action,...or unduly burdensome on...interstate commerce...."[15]

In general, preemption by Federal legislation is not to be inferred "unless the act of Congress, fairly interpreted, is in actual conflict with the law of the state."[16]

III - Consideration by Governmental Entities of the Noise Factor in the Assessment of Highway Projects and Vehicular Operations

Consideration of the noise factor by governmental entities in the planning of highway transportation systems is notorious for its absence. Planning in terms of anticipatory total social impact assessments has not arrived even yet, although there are now strong tendencies in this direction.

Such planning is to be clearly distinguished from the reactive type of ad hoc regulations which have been in existence for some time relating to various types of traffic noise control.[17] Many municipalities have for years required mufflers on motor vehicles and some have restricted horn noise. Most states have long provided statutory requirements for mufflers and several have restrictions on horn noise. Traditionally, local ordinances have provided for subjective standards such as restricting the making of "loud," "unusual," or "unnecessary" noise rather than by establishing quantitative (decibel limit) standards. To some extent, zoning ordinances providing for "quiet zones" have reflected slightly more concern for the long-term welfare of the community.

This situation is beginning to change. Relatively new environmental noise codes in Chicago and Minneapolis clearly represent a dramatic step forward in comprehensive planning for environmental noise control in metropolitan areas. Ironically, the proposed

and seemingly well planned New York City Noise Control Code which sets specific decibel limits for most sound-producing devices (though it retains the City's common law nuisance ordinances for judicial precedent authority) does not undertake to regulate motor vehicle noise, it being assumed that the State has preempted such regulations by forbidding the passage of local ordinances inconsistent with existing State limits.[18] As previously suggested, and hereinafter discussed, the "preemption question" is one which poses serious difficulties for governmental legislative/administrative planning in connection with the abatement of noise attendant to the operation of transportation systems.

At the State level, California has developed a statutory scheme to assure the reduction of highway traffic noise over a period of time. The California Vehicle Code by §23130 prescribes "operational" Vehicle Noise Limits for speed limit of 35 mph or less and for speed limit of more than 35 mph. Section 23130(C) provides that "This section applies to the <u>total noise</u> from a vehicle or combination of vehicles and shall not be construed as limiting or precluding the enforcement of any other provisions of this code relating to motor vehicle exhaust noise." (emphasis supplied) Section 27160 of the Vehicle Code provides that "(a) No person shall sell or offer for sale a new motor vehicle which produces a maximum

noise exceeding the following noise limit..." (with dates and decibel limits prescribed). Colorado and Minnesota have recently enacted legislation which is patterned closely after the California scheme.[19]

The history of the Federal-aid to Highway programs perhaps offers the most useful insights into the environmental noise problem with respect to highway motor vehicle transportation. This program has been primarily concerned with the basic objective of moving masses of people and goods rather than with secondary or derivative environmental amenities.

The Federal-aid Highway legislation of 1916 laid the foundation for a cooperative Federal-State relationship and resulted in the strengthening of State highway departments. The Federal Highway Act of 1921 "led to the rapid development of an integrated network of improved highways throughout the entire country." Also, "In 1921 the War Department made a comprehensive study of the highway routes important to the national defense," a study which was brought up to date in 1935 through the cooperative efforts of the War Department, the Bureau of Public Roads, and the American Association of State Highway Officials. In 1941 the President appointed a National Interregional Highway Committee to investigate the need for a limited system of national highways and to advise the Federal Works Administrator

as to the prospects for utilizing some of the manpower and industrial capacity expected to be available at the end of World War II. The Federal-aid Highway Act of 1944 directed the designation of a National System of Interstate Highways limited in extent to 40,000 miles "so located as to connect by routes as direct as practicable the principal metroplitan areas, cities and industrial centers, to serve the national defense and to connect at suitable border points with routes of continental importance in the Dominion of Canada and the Republic of Mexico."

> The long distances of the transcontinental routes are a by-product of the selection of the most important local and regional highways which articulate into continuous routes. This concept of the system is based upon continuing traffic surveys and flow analyses which show a heavy predominance of motor vehicles making relatively short trips and a small proportion of actually transcontinental highway traffic.[20]

One of the more interesting episodes in the National highway system development concerns the persistent efforts of the late Congressman J. Buell Snyder of Pennsylvania. Commencing with a bill in 1936 directing the Bureau of Public Roads to survey and locate a system of transcontinental and north-south highways, Representative Snyder moved in 1937 to a proposal for a system of "superhighways" 200 feet wide with six traffic lanes, brightly lighted, with no obstructions, so that they could be used as emergency landing strips

for airplanes and further suggested that airports be built at or near the intersections of such highways.[21]

Perhaps most relevant to our present purpose of evaluating the Federal level highway planning process in terms of a total social impact assessment is a review of the Report of the Presidential Advisory Committee on "A Ten Year National Highway Program," attached to the Message of the President, National Highway Program, of February 22, 1955, which was referred to the Committee on Public Works, 84th Congress, 1st Sess., House Document 93. In 1956 the Congress enacted major Federal highway aid legislation which was responsive to the request of President Eisenhower for:

> (A) grand plan for a properly articulated (highway) system that solves the problems of speedy, safe, transcontinental travel--inter-city transportation--access highways--and farm-to-market movement--metropolitan area congestion--bottlenecks--and parking.

While the President's Message directed attention to the "Nation's highway system, other modes of transportation being excluded,"[22] the social sub-system posited for this anticipatory assessment by both the Advisory Committee study and the House Committee on Public Works clearly disclosed an intention to include significant social interactions and implications of the proposed "National highway system." Further,

> The Congressional Committee Report shows that an extremely wide range of engineering, financial,

> and social factors was considered. From our present perspective, however, we would note that some factors were given no attention whatever. The Advisory Committee and the Congress seemed to be much more concerned with the efficient implementation of the highway program rather than with cumulative and qualitative social impacts, particularly those which might be detrimental. No consideration was given to increasing environmental pollution which would result from the growing traffic volume: air pollution from exhausts, engine noise, resulting aesthetic debasement, or the derivative health hazards from the foregoing sources. Nor was a great deal of attention given to the relationship between the increased number and size of motor freight carriers and the possible increased hazards to private auto drivers and passengers.[23]

Taking the Executive-Legislative anticipatory assessment of the Interstate Highway System as the planning reference base for this discussion, let's move ahead 12 years to 1968 when Senate bill S. 2658 was introduced during the 90th Congress which proposed increased maximum size and weight limits for motor freight carriers. It might have been expected that a relatively comprehensive assessment would have been made of the anticipated effects of this legislation. Senate Report No. 1026, Committee on Public Works, U.S. Senate of March 27, 1968, Vehicular Weights and Dimensions, to accompany S. 2658, stated that:

> Among the major issues presented to the committee were those dealing with highway safety, economic impact, effects of increases on road systems and structures and the contributions of the various user beneficiaries.

Actually the Report gave very little attention to these factors other than to the impact of increased weights and widths on the existing road systems and structures. Some attention was given to highway safety and to increased maintenance and construction costs, but the Senate Report, by no stretch of the imagination, could be considered an adequate anticipatory total social impact assessment.[24]

This conclusion was to some extent recognized apparently and even rationally justified as being consistent with the policy enunciated in a letter from the Secretary of Commerce of August 18, 1964, to the Speaker of the House which made the point that such a proposal as that represented in S. 2658 should be considered as only a phase of a continuing process of "progressive implementation" of the Nation's highway system. Therefore, it would seem not only fair but prudent to appraise the S. 2658 assessment in the time-dimensional context of the evolving interstate highway system. If one views the 1968 assessment in the context of the sequence of assessments made by the Congress between 1956 and 1968, a somewhat different perspective can be adopted. Numerous assessments leading to legislation or new regulations relating to air pollution, highway safety, highway beautification, citizen participation in freeway location, and reorganization of the entire Federal transportation regulatory structure were

conducted during the 1956-1958 interim period.[25] Also, pursuant to the Federal-aid Highway Act of 1956, the Secretary of Commerce had undertaken to determine future maximum desirable dimensions and weights for vehicles operating on the Federal-aid highway systems and a report was made to the Congress on August 18, 1964.[26]

The pertinent question remains, however, namely, whether consideration by the Congress of the various highway-related legislation during the 1956-1968 time period was "programmed" in such manner as to schieve a close approximation to a total social impact assessment through time. S. 2658 breezed through the Senate but met strong opposition in the House and was defeated, in large measure, it would appear, because many affected participants brought to the attention of the House members that many of significant "social costs" had not been given appropriate consideration by the Senate.[27] The author has concluded in a previous paper that:

> It is clear that the interim 1956-1968 legislation had the effect of filling in some of the gaps or completing lightly treated segments of the 1956 assessment. It is an interesting question, however, as to the extent to which this was accomplished by deliberate design, by simple response to insistent public or special interest demands, through serendipity from other programs such as air pollution control, or from sheer accident. Only to the extent such legislative proposals were advanced as deliberately designed components of an overall integrated program of Highway/Motor Freight Carrier technology would it satisfy the Total Impact Assessment Model. While the

> aggregative assessments through time did tend to expand the scope of the social sub-system treated, they do not appear to have been, in any real sense, programmed to secure a Total Impact Assessment within a socially permissible time span. The DOT/Bureau of Public Roads policy of "progressive implementation" does not seem to be at all the equivalent of the Total Impact Assessment approach.[28]

It may be contended, of course, that in view of the Congressional committee structure and the customary legislative approach of submitting specific bills to take care of particular problems, it is unrealistic to expect the Congress to conduct total social impact assessments of transportation systems or other public programs either at a specific time or on an aggregative basis through time. The fact remains, however, that the Congress has tended to approach transportation system development for the most part on an *ad hoc*, piecemeal, and non-integrative basis.

Daniel P. Moynihan has asserted that we are moving from a focus on independent programs which "relate to a single part of the system" to policy which "seeks to repond to the system in its entirety."[29] He expects this movement to be a definitive trend in the 1970's. In short, we are giving increasing attention to total social problem contexts or social systems as contrasted with programs directed toward particular parts of such systems which are not coordinated by an over-all policy. "(A) policy approach to government . . . (seeks) to encompass the largest possible range of phenomena and concerns."[30]

Moynihan cites the 1956 Interstate and Defense Highway System as the "largest public works program in history" and states that the eventual judgment will be that it has "had more influence on the shape and development of American cities, the distribution of population within metropolitan areas, and across the nation as a whole, the location of industry and various kinds of employment opportunities (and in all of these, immense influence on race relations and the welfare of black Americans) than any initiative of the middle third of the 20th Century."[31] But he also concludes that "the politics of getting the Interstate Highway Program enacted, decreed, or at least indicated, the narrowest possible definition of its purposes and impact."[32]

Moynihan comments with reference to the planning and implementation of the Interstate Highway System by the Bureau of Public Roads:

> As bureaucrats, their instinct was faultless. Had anyone realized what they were in fact doing, the sheer magnitude of the interests they were affecting, it is nigh impossible to imagine that they would have won acceptance. Indeed, a bare fifteen years after the Interstate program commenced, it is near impossible to get a major highway program approved in most large American cities. But it is too late: most systems have been built. In the process--such at least would be my views--quite appalling mistakes were made, but they were mistakes having to do with issues nominally altogether unrelated to the highway program itself, and so no one was responsible for them . . . .[33]

> Surely it is possible to hope for something more. Government must seek out its hidden policies, raising them to a level of consciousness and acceptance--or rejection--and acknowledgement of the extraordinary range of contradictions that are typically encountered . . . . Surely also it is possible to hope for a career civil service that is not only encouraged, but required to see their activities in the largest possible scope.[34]

Whatever the anticipatory assessment deficiencies of the Congress, it has, in recent years, enacted a number of regulatory schemes which obligate the Department of Transportation to take into account a broader range of social impacts than has been customary in the past. For example, §138 of the Federal-aid to Highways Act of 1968, 49 U.S.C.A. §1653(f)(Supp. 1971) provides in part that "It is hereby declared to be the national policy that special effort should be made to preserve the natural beauty of the countryside and public park and recreation lands, wildlife and waterfowl refuges, and historic sites" and implements this policy with specified requirements placed on the Secretary of Transportation. And the National Environmental Policy Act of 1969 - §102(2)(C) requires environmental impact statements be submitted on all "major Federal actions." Numerous court cases are now being initiated which attempt to secure strict compliance by the Secretary with the provisions of these acts.[35] There will undoubtedly be increasing reaction, however, to the vigorous campaign of the "environmentalists." Even now there is some evidence that many citizens are becoming resentful over the delays in public

project completion resulting from court actions and with the inevitable additional costs incurred by such delays.

Furthermore, certain legislation of recent years makes specific reference to the abatement of highway noise. Starting in 1956, the Secretary of Commerce (duties transferred to the Secretary of Transportation since 1966) was required to "cooperate with the States . . . in the development of long-range highway plans . . . which are formulated with due consideration to their probable effect on the future development of urban areas of more than fifty thousand population." The first active consideration of highway noise at the Federal level was Policy and Procedures Memorandum 20-8 of the Bureau of Public Roads, issued January 14, 1969. Environmental effects, which must be considered by the State or local sponsor seeking Federal aid, are defined to include "noise, air, and water pollution." Pursuant to a 1970 amendment to the Federal-aid Highway Act (PL. 91-605) the Secretary of Transportation is directed "to assure that possible adverse economic, social, and environmental effects have been considered in developing . . . (any Federally aided highway) project . . ." Further, he is to "develop and promulgate standards for highway noise levels compatible with different land uses after July 1, 1972."[36]

IV - Governmental Assessment of the Aircraft Noise Problem

Despite certain disclaimers by the Congress that Federal governmental action has not completely preempted State and local regulation of aircraft noise, it is generally acknowledged that the unique characteristics of air traffic require Federal action for effective control. Hence, this discussion will focus on Federal control of aircraft noise with comments, as appropriate, on State and local noise abatement regulatory efforts. While there have been several successful private suits brought on the theory of a "partial taking" (or inverse condemnation), commencing with United States v. Causby in 1946,[37] it is evident as noted by the court in the 1969 New Jersey case of Township of Hanover v. The Town of Morristown (wherein plaintiffs sought to enjoin the Town of Morristown from enlarging its airport for reason of anticipated increased noise from an expanded airport operation) that "private compensatory damage suits do not accomplish the end objective of noise suppression."[38]

The Department of Commerce Report on The Noise Around Us (1970) asserts that pursuant to the Federal Aviation Act of 1958 requiring each particular model or make of aircraft to obtain an "airworthiness certificate" and an "air operating certificate" that:

> It is clear that the FAA has, . . . full power to prescribe air traffic rules for the "protection of persons and property on the ground," including prescription of air traffic rules in the interest of noise abatement. (p. 146)

While there may have been some doubts about this authority as of 1958, Michael Wollan, in his article on "Controlling the Potential Hazards of Government-Sponsored Technology" indicates that even though noise *per se* was not mentioned in the Federal Aviation Act of 1958, it was generally assumed as of 1961 if not earlier, that the FAA had the authority to prescribe aircraft noise standards. Wollan comments:

> A year later (1961) when Congress made its first appropriation for research on SST feasibility, the FAA discussed more specifically the standards it would use to regulate the SST's engine noise. FAA's new administrator, Najeeb Halaby, told Congress: "We would try to see to it that the noise levels were tolerable to the community or as tolerable as the then existing aircraft."[39]

It was with the passage of the Department of Transportation Act of 1966 that statutory authority was first specifically granted relevant to aircraft noise, but no explicit provision was made for regulation. Section 4(a) of the Act directs the Secretary of DOT to "promote and undertake research and development relating to transportation, including noise abatement, with particular attention to aircraft noise."

All major participants in the national air traffic system have recognized the existing and evolving dimensions of the aircraft noise

problem since shortly after World War II, although the more serious implications might not have become clear until the introduction of jet-powered fleets in the late 1950's. Report No. 1463 of May 23, 1968, of the House Committee on Interstate and Foreign Commerce states:

> The right to use the airspace over the United States in the operation of aircraft has long been established. Aviation has become an essential and widely approved part of our national transportation system. However, aircraft noise and sonic boom are unwanted and unpleasant. At this stage of engine and aircraft development there are no easy nor ready solutions to the continuing and increasing problems.
>
> A subcommittee of this committee first held hearings on aircraft noise in September 1959 at the New York International Airport. The House of Representatives adopted House Resolution 420 in August of 1961 which specifically authorized the Committee on Interstate and Foreign Commerce to investigate the problem, and in February of 1963 the committee published the "Investigation and Study of Aircraft Noise Problems" (88th Cong., 1st Sess., H. Rept. No. 36).
>
> Over the last ten years we have had numerous panels of experts, with representatives from virtually all segments of the aviation industry, as well as from local governments and the Federal Government. Airport operators, manufacturers, air carriers and their associations, local port authorities, municipal groups, NASA, the Federal Aviation Administration, the Department of Housing and Urban Development, and the Department of Transportation have all made contributions looking toward solutions, particularly of the noise problem, but also many of them have been giving increasing attention to the sonic boom problem.

> The noise problem is basically a conflict between two groups or interests. On the one hand, there is a group who provides various air transportation services. On the other hand there is a group who live, work, and go to schools and churches in communities near airports. The latter group is frequently burdened to the point where they can neither enjoy nor reasonably use their land because of noise resulting from aircraft operations. Many of them derive no direct benefit from the aircraft operations which create the unwanted noise. Therefore, it is easy to understand why they complain, and complain most vehemently. The possible solutions to this demanding and vexing problem which appear to offer the most promise are (1) new or modified engine and airframe designs, (2) special flight operating techniques and procedures, and (3) planning for land use in areas adjacent to airports so that such land use will be most compatible with aircraft operations. (pp. 3-4)

Congressional hearings in 1962 "confirmed a 1960 House Committee recommendation that 'noise criteria be mandatory requirements in drafting specifications for future . . . aircraft,'" since the lack of "maximum noise" criteria established by the Federal government appeared to have been a "deterrent to manufacturers to achieve greater noise suppression." It is obvious that competitive considerations restrained the aircraft engine manufacturers from allocating substantial research resources to aircraft noise abatement. Rather the objective was to "build engines and aircraft (with) maximum performance characteristics without regard to noise."[40] However, there were R&D efforts at the Federal level during the 1960's

to cope with the aircraft noise abatement problem, as for example, the NASA "Quiet Engine" project.[41] Nevertheless, despite the pre-emption by the Federal government over aircraft flight operations pursuant to the Federal Aviation Act of 1958 and what might plausibly appear to be a corresponding responsibility for the full consequences of such operations, including noise suppression, the Federal government, overall, moved slowly. This would seem to have been an inevitable consequence of the 1962 Supreme Court case of Griggs v. Allegheny County[42] which held the airport operator liable for damages, including noise caused to a homeowner by aircraft operations and, therefore, completely absolved the airline operators and the Federal government from any responsibility whatsoever.

The authority of the Griggs decision had the effect of obstructing the coordinated efforts required of all involved participants called for by the OST Jet Aircraft Noise Panel in 1966 to abate aircraft noise.[43] Further, Congress gave some thought to the possibility of the Federal government's indemnifying all airport operators throughout the U.S. against judgments obtained against them for noise damage alleged under the Griggs doctrine but found this to be "impracticable."[44] Hence, it was not until the passage of §611 in 1968[45] relating to the abatement of aircraft noise and sonic boom and the subsequent promulgation by the FAA of noise standard

regulations on December 1, 1969, pursuant thereto, that the aircraft engine manufacturers and the airlines had a compelling incentive to introduce noise reduction criteria into their planning and operations.

FAA Type Certification of commercial aircraft delivered after December 1, 1969, under Part 36 of the FAA Aircraft Regulations, is perhaps the most significant Federal action to date for control of aircraft noise. The DC-10 and Cessna Citation 500 have been certificated, and the L-1011 and all subsequent subsonic aircraft will have to comply with Part 36; the Boeing 747 was allowed until December 1, 1971, for compliance. These planes are significantly quieter than older planes, but effectiveness of Type Certification at a given point in time will depend on the make-up of the fleet at that time. Projections by the Air Transport Association estimate that by 1975 only 18.6% of the fleet will have been certificated under Part 36. Thus, to the extent that it depends upon type certification as presently structured, the noise problem will have been only slightly relieved by 1975 and could remain significant until 1990.[46]

Regulations with respect to retrofit, sonic boom, SST type certification, and STOL/VOTL type certification are still in the developmental stages.[47] Of all potential regulations, retrofitting would most likely bring about the most effective noise reduction

in the short-term, while type certification regulations will probably be most effective in the long run. Of course, effectiveness will depend upon the maximum permissible noise levels set. The abatement effects of modest noise reduction requirements with respect to type certification could be more than offset by an increase in air traffic in certain situations.

As a result of the pervasive Federal regulation of air transportation pursuant to the Federal Aviation Act of 1958, State and local jurisdictions have been effectively precluded from control over aircraft noise. Local ordinances undertaking to control noise, as, for example, by prohibiting flights over the city at less than 1,000 feet, have been struck down for being in conflict with FAA regulations or for imposing an unreasonable burden on interstate commerce, or both.[48] On the other hand, it is quite clear that the Federal government has not accepted a level of responsibility for aircraft noise abatement (in terms of timely R&D and regulatory measures to reduce noise at the source) which corresponds to the magnitude of control it exercises over air transportation. Yet, the Griggs doctrine places liability for aircraft noise on the airport owner-operator which is, in most situations, a State or local governmental entity. Furthermore, the threat of massive damage awards is definitely increasing since the aircraft noise situation is worsening in many areas.[49] While it may be generally agreed that air transportation must be regulated

at the national level, the lack of a corresponding national effort to abate one of its most distressing side-effects encourages resort to the courts as the only means of prodding, indirectly, a sluggish Federal system into action.[50]

Since the states and municipalities as airport owners-operators must bear the direct and immediate burden of complaints from the noise-abused public, they have seized upon whatever interstitial measures are available (governmental, technical, economic, etc.) to lessen the impact of community complaints and noise damage judgments. Notable in this connection is the doctrine of proprietary control over airport operations which has its source in the concept of private ownership and operational status as distinguished from operation of the airport by a State or local governmental entity in its governmental capacity.[51] While the Port of New York Authority has been able to maintain noise standards set by itself (less stringent, however, than FAA standards for new aircraft) and the new California regulations on noise standards for airports are essentially grounded on the "power of airport proprietors," this regulatory technique has severe limitations. This is particularly true for short-term relief since most major airports are now situated in densely populated areas and proprietor control over noise reduction at the source is essentially non-existent. The FAA has clearly preempted aircraft operations as to

safety. As to noise, the airport operator is left with whatever marginal control he can exercise through such a measure as "planning runway utilization schedules to take into account adjacent residential areas, noise characeristics of aircraft and noise sensitive time periods" which is provided, among other methods, in the California noise regulations for airports.[52] While the proprietary doctrine may provide the airport operator some small but useful bargaining leverage vis-a-vis the Federal government in the present evolutionary phase of aircraft noise regulation, it is based on a questionable legal assumption, the future efficacy of which is in doubt; namely, that an instrumentality of the state, acting in a private, non-governmental capacity, has a degree of control over the activities prescribed in its State-originated charter which the state itself is precluded from exercising.

Federal legislation since the enactment of §611 in 1968 provides some support for aircraft noise abatement. Noise is an environmental impact and should be considered in §102(2)(C) environmental impact statements for airport development and modification. There are no Federal noise standards for airports. The Airport and Airways Development Act of 1970 declares it to be "national policy that airport development projects authorized pursuant to this part shall provide for the protection and enhancement of the natural resources and the quality of the environment of the nation." This Act also provides for public hearings on airport projects, if requested.

An evaluation of the Federal role in aircraft noise abatement planning must be approached with some caution and many qualifications.

Approximate total social impact assessments have been initiated at the Federal level as studies; for example, Report of the Jet Aircraft Noise Panel of the Office of Science and Technology, Executive Office of the President, on Alleviation of Jet Aircraft Noise Near Airports of March, 1966, and the Joint DOT/NASA Civil Aviation Research and Development Policy Study of March, 1971. However, these studies were not intended for and have not led to the development of a national plan for aircraft noise abatement. Perhaps more illustrative of the comprehensive planning approach are the Metropolitan Aircraft Noise Abatement Policy Studies (MANAPS) of HUD/DOT initiated in 1969 which are now being developed into a Planning Guidelines Manual for use by metropolitan communities in the modification of existing airports or the location of new airports. The central thrust of this effort is to provide alternative strategies for achieving land use development compatible with airports.

There are, of course, plausible reasons which can be advanced to rebut the implied suggestion above that the Federal government, in view of its preemption of control over aircraft operations, might reasonably be expected to assume a commensurate responsibility for aircraft noise abatement. For example, the problem might be handled in several ways, including: abatement at the source (reducing engine noise); reduction of the effects of noise as by buffers, insulation, or compatible land use management; and provision for compensation for those harmed by aircraft noise. The Federal government has restricted its efforts primarily to noise reduction at the source as reflected in the enactment of §611. It has rejected the assumption of liability for aircraft noise as it was

privileged to do pursuant to the Griggs case. It has not intervened in the land use management function, this being a traditional prerogative of State and local jurisdictions under the "police power."

The upshot of the situation described is that municipalities, whose citizens are directly and adversely affected by the noise, must suffer the social costs without benefit of regulatory authority. This being the existing condition, states and cities have grasped whatever legal and non-legal devices are available to protect themselves from liability as well as to reduce the complaints of noise-abused citizens. This is why the proprietary doctrine has been asserted and to some extent applied by the Port of New York Authority. And the Preamble of the Noise Regulations for California Airports states, somewhat unconvincingly it might be added, that:

> These standards are based upon two separate legal grounds: (1) the power of airport proprietors to impose noise ceilings and other limitations on the use of the airport, and (2) the power of the state to act to an extent not prohibited by federal law.

The fact of the matter is that this control is marginal at best. Further, noise abatement programs involving comprehensive land use schemes are either so costly or so long-term or so politically-charged that such alternatives offer little short-term surcease. States or localities would seem to have some appreciable degree of control over aircraft noise effects only with respect to new airport developments.

The Minnesota Airport Zoning Act (Chapter 1111, 1969 Session Laws) is a notable illustration of this type of State/local initiative, providing for appropriate regional governmental entities, eminent domain powers, land use and development controls, and intergovernmental tax sharing arrangements which may assure minimum noise intrusion if a major new airport is constructed in the Minneapolis-St.Paul metropolitan area.

V - The Critical Assessment-Planning Task: Evaluating the Social Benefit of Noise Abatement

The two preceding sections have touched briefly on the extent to which the noise factor has been considered in the planning of transportation systems as reflected by actions of various legislative and regulatory entities at the Federal, regional, state and local levels. Such actions represent the prescribing phase of the public decision process rather than the preceding assessment/planning phase. Surely, if the program planning phase, supported by an anticipatory project assessment component, has any vital relevance to the effective public decision process, it should influence the prescribing phase either at the legislative or regulatory level or both. Hence, one of the critical questions relates to the extent to which the available hard, demonstrable data (concerning such factors as technological feasibility, economic costs, degree of safety provided, social behavioral patterns, etc.) associated with and offered in support of recommended noise emission standards actually support such standards to the satisfaction of the responsible legislative or regulatory body. Noise standards reflect, in part, a normative or social value judgment by the prescribing entity, presumably determined to be in the public interest. Therefore, the task of evaluating the social impact of identified noise effects in particular contexts or in similar

patterns of noise intrustion contexts cannot be escaped. Put otherwise, how much is it worth to reduce the noise level by so many decibels within a given period of time? This question has many variations depending upon the particular decisional context, including the decisional arena, i.e., judicial, regulatory, municipal council, the Congress, etc.

It is submitted that this is a, if not <u>the</u>, crucial question for the adjudicating or prescribing entity; it is also the crucial question for transportation systems planners if the latter expect to influence the standards prescribing entity.[53] A few examples should suffice to demonstrate the diversity of decisional contexts in which some evaluation is made, explicitly or implicitly, of the social detriment of noise intrusion or, conversely, the social benefit of noise reduction or elimination.

Consider the <u>judicial arena</u>. While court cases are customarily concerned with remedying adverse consequences of inadequate past planning rather than with assessments of proposed projects, judicial decisions do provide some simplified and approximate evaluations of the social significance of "unwanted sound." Legal recognition of noise intrusion can best be illustrated by cases in the eminent domain (highway right-of-way) context, including inverse condemnation suits. Where there has been no "taking," the vast majority of jurisdictions,

if not all, refuse any legal remedy for highway construction/traffic noise *per se*. This can be interpreted as placing zero (or *de minimis*) value on noise. Where there has been a "partial taking," about half the states recognize noise as an element of consequential damages. Put otherwise, in these jurisdictions noise can be considered in determining the difference in the fair market value of the property before and after the taking, such difference in the fair market value representing the compensation due the landowner.

In 1971, a Superior Court Judge in Elizabeth, New Jersey, made an award of $164,119 to the local Board of Education which had alleged damages caused by noise interference with the conduct of classes in a local school after Interstate Highway 278 was constructed next to the school.[54] In 1965 the Highway Department had condemned 2,034 square feet of the school's property for the highway for which the School Board was awarded $3,700. After the highway came into use, the noise level increased from about 60 decibels to approximately 80 decibels. Interference with normal speech commences at the 65-70 dB level. The court's judgment included $94,350 as the cost of air-conditioning the school and $51,000 as the cost of sealing all the windows.

This judgment prompts a number of observations and questions. On the basis of legal precedent, half the states might have gone along with the $3,700 eminent domain award, ignoring the noise intrusion

altogether. In short, no social value would be placed on noise intrusion or noise abatement. Possibly, the courts of half the states would have attempted to increase the award by an amount representing harm caused by the noise intrusion. In the subject case, did the cost of air-conditioning the school building accurately reflect the harm incurred to the educational process by the noise intrusion? Was this the only concrete/operational means of giving a measurable magnitude to the noise intrusion? If not, then taking into account the probability of the noise, its magnitude and duration, and the resultant interference with the educational process, how is the latter effect to be given some measurable social value dimension? If the Highway Department had undertaken to work out an initial compromise settlement with the School Board, would it have been based on the same considerations as the court's judgment or measured in some other way? Could not the Highway Department have considered a two-mile, 35 mph rather than a 60 mph speed zone in the vicinity of the school? This would have greatly reduced the noise interference. Was the judgment at least implicitly made that this reduction in speed of interstate vehicles would be a greater social detriment than the noise intrusion on the school's educational function?

What were the options available to the court in this instance? We can assume that this court had no authority to abate the noise at

the source, i.e., relocate the highway or control the noise emission levels of vehicles moving in interstate commerce or other aspects of interstate traffic. Apparently, the court considered it impracticable, if not impossible, to determine directly compensation for harm which would be done the educational process as well as possible physical and psychological injury to individuals. Hence, the remaining option was to in some manner reduce the effects of the noise. Presumably, effective buffering (as by sound barriers) was considered impractical. Relocating the school would have, no doubt, posed far greater difficulties and expense than sealing and air-conditioning the building. Hence, did the court select the least costly, practical option available? It must have appeared to the court that the award represented a reasonable evaluation of the social impact of the noise intrusion. But what if the cost of sealing and air-conditioning had come to $500,000? Do the data and appropriate analytical techniques exist by which the prospective harm to the educational process and to individuals might have been calculated so that an award based on noise effects rather than on the cost or reducing the effects could have been made? If so, would this have been a more satisfactory mode of evaluating the social impact of the noise intrusion than the means adopted by the court?

Parenthetically, it might be observed that some analysts, in the example given, would employ the notion of social impact only with

reference to the evaluation of the actual social impact of the highway noise on the educational process and in terms of physical and psychological harm to individuals. This definitional approach would make a distinction between compensation for the harmful effects of the noise on the one hand and the cost of abating the noise at the source or reducing the effects of the noise on the other. The latter two alternatives would not be considered "surrogate" alternatives of the social impact of the noise. It might be contended that the cost of noise reduction (as by air conditioning) would be small compared with the long-term harm done the educational process and to individuals. Even assuming so in this instance, however, in other contexts the cost of abatement at the source or reduction of effects could far exceed the actual harm to individuals or to community value-institutional processes. While the analytical approach may best be left to the needs of a particular assessment/decisional context, it would appear that the cost of abatement at the source or the cost of reducing the effects of noise, as in the New Jersey case, could be considered, consistent with customary usage, as means of "internalizing" the social costs of environmental noise.

If the task of evaluating the social impacts of noise effects in the judicial arena seem to pose certain difficulties, the task takes

on even greater complexity in many assessment/planning functions in legislative/regulatory arenas. Only a few illustrations can be touched on here which necessarily involve the evaluation of social benefit of reducing noise levels by certain amounts over given periods of time or of avoiding the exposure of particular social activities to specified noise levels.

Retrofit Regulations: Federal Aviation Administration

Should the FAA undertake to establish Rules and Regulations pertaining to the retrofit of jet aircraft certified prior to the Boeing 747, the Administrator, pursuant to §611, is required to take into account whether any proposed standard would be "consistent" with the highest degree of safety in air commerce or air transportation in the public interest" and to "consider whether any proposed standard,. . . is economically reasonable, technologically practicable, and appropriate for the particular type of aircraft, aircraft engine, appliance or certificate to which it will apply." Obviously, the social objective of reducing aircraft noise is circumscribed by considerations of safety, cost, and technological feasibility. Not only will these factors place maximum limits on the noise reduction which can be realistically expected, but

within these limits, the noise reduction standard will probably be arrived at by a process of "balancing" increments of noise reduction with the other factors in order to arrive at an "optimum" standard - or optimum set of regulations pertaining to all types of jets considered for the retrofit program. This balancing process inevitably involves an evaluation of the social significance of aircraft noise reduction by given amounts within specified periods of time. However, the intensity of public demand for aircraft noise reduction may result in the establishment of inflexible standards which must be met within a given period of time. In such event, the other factors would simply have to be adjusted so as to assure achievement of the regulatory norm.

Center City STOLport Configuration: City Council or Metropolitan Governmental Unit

Should a given city or metropolitan area government undertake to assess and plan for a new center city STOLport to satisfy urgent demands for increased inter-city air traffic capacity it would be compelled to consider, in many instances, the clearance of several

city blocks by condemnation and the relocation of the displaced residences, businesses and public facilities. This would be an enormously costly undertaking. Assuming knowledge of an appropriately designed STOL plane, the characteristics of the required STOLport and the probable air traffic patterns, the question will arise as to the perimeter of the land area to be condemned (with exceptions for activities which can accommodate to the higher noise levels which would be introduced). The responsible decision-making entity will be directly confronted with the problem of deciding the compatibility of various community land uses and activities with particular noise levels. Should all residences be condemned within the 40 NEF contour, the 35 NEF contour, or the 30 NEF contour? The cost will increase drastically as the perimeter is pushed out. So how does the decision-maker evaluate the social benefit of expanding the perimeter from the 35 to the 30 NEF contour? The problem is, of course, far more complex than stated here. If land is condemned only out to the 40 NEF perimeter, then

the City Council may be faced with multiple suits in inverse condemnation for partial takings or would be obliged to purchase avigational easements, possibly out to the 30 NEF contour.

Selection of Noise Abatement Strategy for An Existing Airport: City Council or Metropolitan Government Unit

A problem far more complex than the new STOLport example would probably confront a local governmental entity attempting to select an appropriate noise abatement program for an existing airport in a built-up area. Primary types of abatement alternatives include:

- Use of preferential runways
- Traffic allocation among metropolitan airports if more than one exists
- Airport redesign: runway length and direction
- Insulation of structures in adjacent areas
- Encouragement of compatible land use through short and long-term legal and economic incentives
- Selective relocation of schools and other noise-sensitive activities
- Compensation for noise intrusion

It is readily apparent from the HUD Metropolitan Aircraft Noise Abatement Policy Study (MANAPS) that

literally dozens of alternative strategies might plausibly be considered, based on various combinations of the above noted primary means of noise abatement. These will involve different economic costs, different degrees of disruption and inconvenience, different time frames for implementation, varying degrees of legal, institutional, and social obstruction, and different levels of noise reduction. So again, the question arises: just what social value is to be placed on noise reduction in the particular noise abatement context?

<u>Legislation to Establish Federal Noise Emission Standards for Non-Aircraft Noise Sources: The Congress with Implementing Regulations by EPA/ONAC</u>

Development of a statutory scheme and implementing regulations for applying Federal noise emission standards to non-aircraft noise sources may be the most complex, certainly the most far-reaching in its consequences for noise reduction, of all the noise abatement strategies. Most environmental noise abatement control has been initiated at the local level through specific ordinances or truncated

codes. State regulation has been limited, primarily to internal combustion engine sources. It now is rather obvious that a coordinated program for environmental noise abatement must be shaped at the national level. A start in this direction was made with the enactment of the Noise Pollution and Abatement Act of 1970. §401(c) provides for consolidation of the reviewing function of noise-producing activities by the Federal agencies in EPA/ONAC. This approach necessarily involves uniformity of standards and inevitably will come into conflict with the diversity of regulatory measures required for effective control of particular noise environments at the State and local levels. Further, new Federal standards will surely wipe out some existing State and local noise regulatory schemes on which the responsible governmental entities have expended great effort, time, and expense. Hence, highly intricate questions will arise with respect to the social value of environmental noise reduction, not merely with reference to specific noise contexts but also in terms of optimum noise

reduction in the aggregate of noise environments across the nation. An elaboration of the complexities involved in this task are reviewed in various recent reports and papers.[55]

Another way of posing the task of evaluating the social impact of noise effects is to ask: how can available scientific, technological, economic, and social behavioral data and analyses be applied by the assessment/planning entities so as confidently to establish the parameters within which realistic noise reduction goals, regulations, and standards can be prescribed? Acknowledging that heated disputes often arise over the validity of even so-called "scientific" data, there would seem to be, nevertheless, a considerable reservoir of consensus data and analyses concerning what is practicable with respect to noise abatement within given periods of time, the economic costs of alternative abatement strategies, and what the socio-political effects will be. Therefore, the question may be asked: how far have we moved toward the application of available data and analyses in the setting of noise standards, thereby eliminating a corresponding degree of needless and obfuscating partisan contentiousness? Hopefully, we are making some progress. This is not said to denigrate adversarial system. Judgments pertaining to the social significance of various

noise effects and the manner in which the costs and benefits of noise abatement programs are to be shared are matters which properly fall within the ambit of adversarial process.[56] Judgments on such matters as these involve alternative concepts of social justice, and the application of such concepts in particular decision contexts constitute appropriate subjects for competing views in the public decision process.

One further point of considerable importance needs to be made. While at some point in time the responsible prescribing entity must accept an anticipatory assessment outcome and a planning strategy for implementation based thereon, this should not be the end of the matter. After all, the objective is to achieve prescribed environmental noise reduction. But in order to determine if the actual noise levels of target sources or environments are in fact being reduced, all Federal, State and local noise abatement programs must be monitored and evaluated on a continuing basis so that modifications, as necessary, can be introduced into these programs periodically. Effective noise abatement involves a continuing evaluative function - not simply a "one shot" decision.

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V. CASE STUDIES

D. Genetic Technology: Promises and Problems

Mark S. FRANKEL

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by a special hospital committee, that have caused delays for women seeking official approval. As a result of the ruling, therefore, restrictive state anti-abortion laws have been declared unconstitutional.[71]

APPLYING GENETIC TECHNOLOGY

The techniques reviewed in the previous section have improved considerably man's capability for controlling genetic disease. At the same time, however, their application raises new and complex issues. Questions concerning "when" and "how" genetic technology will be employed and who will be its "employer" are fraught with legal, social, ethical and political ramifications. And whether the answers to these questions will be framed within the context of long-range societal goals or the immediate amelioration of individual or family problems will have important consequences for developing policy. The remainder of this paper will explore some of these issues, emphasizing the variables which contribute to their complexity.

I. Treating Genetic Disease

Two modes of therapy should be considered: current medical treatment and gene therapy. In the case of the former, most would agree that if an appropriate treatment is available it would be morally reprehensible not to provide it to all those in need. Modern medicine, guided by man's compassion for man and its commitment to the individual, makes no distinction between the sources and types of diseases or the individual "worth" of its patients.

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[71] Even the four states -- Alaska, Hawaii, New York and Washington -- that have permitted unrestricted abortions will probably have to alter their laws. These states have residency requirements which the Court struck down.

Prevailing professional and social mores "demand that all persons have recourse to all reasonable medical expertise . . ."[72] Providing proper care to all those in need, however, is not without its consequences.

A. Cost of treatment: One problem is the cost involved in providing the treatment. In the case of cystic fibrosis, the most common autosomal recessive defect in the white population, a recent study found that the costs were so high that "families who have been able to attain a moderate income . . . may be reduced to the poverty level by chronic health problems . . ."[73] The study also revealed the inadequacy of private health insurance, with the finding that 31 per cent of the children "were unprotected by medical insurance and only one-fourth had sufficiently comprehensive coverage to include outpatient expenses and medication."[74] Another example is hemophilia, for which the cost of treatment can be $12,000 per year for each hemophiliac or approximately $480 million for all Americans suffering from the disease.[75] Most American families would be unable to afford such treatment. Should the

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[72] Stevenson and Howell, op. cit., supra, n. 55 at 31.

[73] Audrey T. McCollum, "Cystic Fibrosis: Economic Impact Upon the Family," The American Journal of Public Health, Vol. 61, July 1971, p. 1340.

[74] Ibid. When insurance was available to families on an independent basis, the study found the cost of premiums to be as high as $40-50 per month. Blue Cross has established a system under which families having a child with Cooley's Anemia can be reimbursed for transfusion costs even when their child is treated as an outpatient. The plan is being set up on a one-year trial basis and judgment regarding its effectiveness must be reserved until the end of that time. See B.J. Culliton, op. cit., supra, n. 49 at 591.

[75] K.M. Brinkhous, "Changing Prospects for Children With Hemophilia," Children, Vol. 17, November-December 1970, p. 222.

cost be absorbed by society? Can society then require that to receive such treatment a patient must fulfill certain conditions?

A recent case in Pennsylvania emphasizes the implications of the latter question.[76] A mother was initially informed by state officials that in order to receive treatment for her 12-year-old hemophiliac son she would have to go on welfare. The requirement was subsequently rescinded by the governor, who then told the family that they would have to recruit 36 donors a month and drive 100 miles to Philadelphia to donate blood in exchange for their son's treatment. The family, understandably perturbed, is now involved in negotiating a compromise with the State.[77] One must seriously question the intent of imposing such conditions on a family. Are there acceptable limits to such conditions? What criteria should be used for determining those limits? And with whom does that responsibility rest? A recent court suit demonstrates the challenge that lies ahead. Four young hemophiliacs have filed suit in federal court demanding that the government provide them and all other hemophiliacs in the country with the treatment necessary to allow them to bleed normally. The suit contends that the youths were denied the "equal protection" guaranteed by the 14th Amendment, citing the government maintenance programs for drug addicts.[78] Thus, the familiar problem of allocating resources becomes even more acute with the emergence of new genetic technology.

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[76]The following account is taken from articles appearing in the Washington Post, November 2, 1972, p. K3 and November 6, 1972, p. A20.

[77]As a result of this incident, it was recently announced that Pennsylvania had established a program to give free treatment ot hemophiliacs. See the Washington Post, December 5, 1972, p. A4.

[78]Washington Post, October 11, 1972, p. A18.

B. Health Consequences of Treatment: Another unanticipated consequence associated with treating genetic disease can be illustrated by examing the treatment for PKU. As already noted (<u>supra</u>, p. 17), the fetus of a phenylketonuric woman is exposed to high concentrations of phenylalanine metabolites and, as a result, it may experience severe retardation and heart defects.[79] Thus, the medical science which enabled those mothers to lead relatively normal lives now threatens to deny their children the same benefits. Theoretically, correction of the metabolic disorder should prevent damage to the fetus. From a medical standpoint, however, reinstatement of the low phenylalanine diet poses two problems. First, "the health status of the phenylketonuric woman may not justify the difficulties involved in attempts to control diet."[80] And second, there is the possibility that reinstatement of the diet may "result in nutritional deficiency which may be as detrimental to the fetus as maternal phenylketonuria itself."[81] Under these circumstances, should the mother be encouraged not to conceive at all? If she insists on having a child, what is the physician's responsibility with regard to reinstating the special diet? Since the birth of such irreparably damaged children will result in life-long institutional care, does society have a right

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[79] According to R.R. Howell and R.B. Stevenson, "virtually every infant born to a woman who meets the criteria for classic phenylketonuria will have major defects, with growth retardation and microcephaly as well as other structural abnormalities." "The Offspring of Phenylketonuric Women," <u>Social Biology</u>, Vol. 18 (Supplement, 1971), p. S27.

[80] V. Elving Anderson, "Discussion: Maternal Effects in Genetic Disease," <u>Ibid</u>., p. S32.

[81] R.O. Fisch, D. Doeden, L.L. Lansky and J.A. Anderson, "Maternal Phenylketonuria: Detrimental Effects on Embryogenesis and Fetal Development," <u>American Journal of Diseases of Children</u>, Vol. 118, December 1969, p. 855.

to intervene in preventing such births? The consequences noted for PKU have been linked to other maternal disorders as well,[82] Thus increasing the proportions of the problem.

C. Treatment by Gene Therapy: Although the development and application of techniques for gene therapy are a number of years into the future, their potential impact warrants serious consideration at this time. The high degree of uncertainty and potential risks involved in using gene therapy clearly distinguish it from more conventional modes of therapy. Perhaps even more important, however, is that both the uncertainty and the risks will affect future offspring as well as the present generation. Friedmann and Roblin write that "For an acceptable genetic treatment of a human genetic defect, we would require that the gene therapy replace the functions of the defective gene segment without causing deleterious side effects in the treated individual or in his future offspring."[83] They conclude that "although the ethical problems posed by gene therapy are similar in principle to those posed by other experimental medical treatments, we feel that the irreversible and heritable nature of gene therapy means that the tolerable margin of risk and uncertainty in such therapy is reduced."[84] They support the need for continued research into the technology of gene therapy and propose eithico-scientific criteria for applying these techniques. However, they oppose using gene therapy in human patients at this time because of man's limited understanding of genetic processes and of how they might be affected by technological

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[82] Stevenson and Howell, op. cit., supra, n. 55 at 35.

[83] Friedmann and Roblin, op. cit., supra, n. 53 at 952.

[84] Ibid., p. 953.

intervention.[85] The tone of their presentation, however, suggests that gene therapy should and will become a useful method for medical treatment. Theologian Paul Ramsey, however, is less certain about the use of such therapy. He writes that "the unknown and unforeclosed risks to future generations may outweigh any benefit that might be secured for the individual patient. In a matter of such grave importance, 'no discernible risk' is not adequate protection. We need to know that there are no risks - a requirement which inheritable gene therapy is not apt to meet."[86] Ramsey is undoubtedly correct when he contends that complete knowledge regarding the possible risks of gene therapy is unlikely ever to be realized. Under such circumstances, then, gene therapy affecting future generations would be prohibited if Ramsey's criterion was observed. Ramsey believes that the choice is not simply between doing nothing about an inherited disease and correcting it by gene therapy. Alternative choices would include "having no children or fewer children. The treatment would be continence or not getting married or using three contraceptives at the same time or voluntary sterilization."[87] In light of the uncertainty and high risks involved in gene therapy, Ramsey finds more acceptable these other alternatives for "treating" genetic disease.

The two points of view outlined above converge at the crucial policy questions: Are there any conditions under which certain types of gene therapy

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[85] Ibid., p. 954.

[86] Paul Ramsey, "Genetic Therapy: A Theologian's Response," in Michael Hamilton (ed.), The New Genetics and the Future of Man, (Wm. B. Eerdmans Publishing Co.: Michigan, 1972), p. 169.

[87] Paul Ramsey, Fabricated Man, (Yale University Press: New Haven, 1970), p. 118.

should be prohibited or encouraged? What criteria or guidelines should be used for determining those conditions? And with whom do these responsibilities rest? These questions challenge both the scientific and ethical dimensions of the policy-making process.

D. Treatment and the Gene Pool: Perhaps the most frequently cited consequence of treating genetic disease is its impact on the human gene pool, i.e. the total genetic information possessed by the reproductive members of the population. The present gene pool is the result of 3 billion years of evolution and natural selection. Nature is successful in protecting the human species from detrimental genes because potential carriers either die prior to reproducing or reproduce less frequently than other heriditary types. The problem, as viewed by a growing number of people, is that medical advances have altered this situation by reducing the impact of natural selection. New treatment permits the survival and reproduction of persons with inheritable disorders who in earlier times would not have reproduced. As a result, the human gene pool experiences a higher frequency of many defective genes. For example, approximately 90 per cent of the children who formerly died from retinoblastoma - a malignant tumor of the eye - are now surviving because of advances in surgery and chemotherapy. Many of these children will be blind, but certainly able to reproduce and, consequently, to transmit the deleterious gene to their progeny.[88] Gene therapy which did not affect reproductive cells would produce similar results. Treated individuals would still pass the

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[88] Reisman and Matheny, op. cit., supra, n. 15 at 205.

defect on to their offspring, thus requiring more and more gene therapy.

What are the likely consequences if the genetic load is permitted to increase? According to some, the quality of the gene pool will continue to deteriorate and greater demands will be placed upon the community's medical services, since more people will be dependent on medical care and treatment. Ramsey foresees "some future generation [which] will begin to experience 20 percent genetic deaths."[89] And Bentley Glass draws the following scenerio:

> to contemplate the man of tomorrow who must begin his day by adjusting his spectacles and his hearing aid, inserting his false teeth, taking an allergy injection in one arm and an insulin injection in another, and topping off his preparations for life by taking a tranquillizing pill, is none too pleasant.[90]

What is good for today's individual and his generation may be detrimental to future populations, and unless some action is taken "the whole genetic capacity of man will be much weakened."[91]

This bleak picture has prompted the suggestion of measures designed to cope with the deteriorating gene pool. Such measures rest on the belief that the present pattern of genetic selection is much less desirable than that which could be achieved by a deliberate and controlled effort. Two types of proposals are frequently suggested. The first is a program designed

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[89] Paul Ramsey, "Moral-Religious Implications of Genetic Control," in John D. Roslansky (ed.), Genetics and the Future of Man, (Appleton-Century-Crofts: New York, 1966), p. 111.

[90] Bentley Glass, "Human Heredity and Ethical Problems," Perspectives in Biology and Medicine, Vol. 15, Winter 1972, p. 243.

[91] Julian Huxley, quoted in Sol Tax and Charles Callender (eds.), Evolution After Darwin, Vol. III, (The University of Chicago Press: Chicago, 1960).

to alter genetic composition by encouraging desirable traits, i.e. "positive" eugenics.[92] The second is designed to alter genetic composition by reducing the incidence of undesirable traits, i.e. "negative" eugenics. The latter alternative might be accomplished by persuading those who have a high likelihood of transmitting a genetic defect not to reproduce, by sterilization, or by abortion of fetuses diagnosed as genetically abnormal.

The "deteriorating gene pool" argument is not without its critics. They contend that the predicted danger of a genetic apocalypse is erroneously calculated. They see no "imminent danger of being overwhelmed by the bad genes . . . we would seem to have no reason to fear that the normal population will soon be replaced by that of individuals with abnormal genetic factors."[93] One force working to reduce the genetic burden is current demographic trends. "In the short run, demographic trends (in and of themselves) are reducing the incidence of serious congenital anomalies."[94] Trends indicating smaller family size and a lowered average age of childbearing will work to ameliorate the quality of the human gene pool.

Another criticism concerns the nature and severity of genetic disease. "Many a 'bad' gene whose effects are overcome euphenically [i.e. by medical treatment] may be said to have lost its 'badness,' wholly or to a large degree so that its accumulation no longer represents a serious biological load even

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[92] See supra, n. 66, for a discussion of the implications of such programs.

[93] Reisman and Matheny, op. cit., supra, n. 15 at 204.

[94] Dudley Kirk, "Patterns of Survival and Reproduction in the United States." Proceedings of the National Academy of Sciences of the U.S.A., Vol. 59, March 1968, p. 669.

though it may represent a considerable economic load."[95] For example, if a disease such as diabetes can be controlled by artificially altering the environment, i.e. providing easy acquisition to insulin, then any real harm to individuals is negated. Thus, "environmental changes have made some hereditary defects irrelevant";[96] it seems reasonable to expect similar medical advances in the future.

There are those who also question an underlying assumption of proposals designed to "protect" the gene pool - that such protection is an obligation of this generation to future generations. Professor Martin P. Golding contends that "We are thus raising a question about our moral relations to the community of the remote future. I submit that this relationship is far from clear, certainly less clear than our moral obligations to communities of the present."[97] It seems highly unlikely that today's generation can accurately predict the needs and wants of succeeding generations.

> One might go so far as to say that if we have an obligation to distant future generations it is an obligation not to plan for them. Not only do we not know their conditions of life, we also do not know whether they will maintain the same (or a similar) conception of the good life for man as we do.[98]

Even if it could be agreed that there are real and identifiable obligations

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[95]Philip Handler (ed.), Biology and the Future of Man, (Oxford University Press: New York, 1970), pp. 910-911.

[96]Kirk, op. cit., supra, n. 94.

[97]Martin P. Golding, "Ethical Issues in Biological Engineering," UCLA Law Review, Vol. 15, February 1968, p. 453.

[98]Martin P. Golding, "Obligations to Future Generations," The Monist, Vol. 56, January 1972, pp. 97-98.

to future generations, there is still the problem of deciding how to balance those obligations against the obligations to the present generation.

Any attempt to manipulate the existing gene pool might not only foreclose possible options of future generations, but might also adversely affect their biological adaptability. The genetic diversity of the human gene pool has long been recognized as necessary for ensuring adaptability to future environments, so essential to survival in the face of constant evolutionary change. "Genetic diversity is in one sense capital for investment in future adaptations. Since genetic variability represents evolutionary capability, it is a load we should be ready and willing to bear."[99] It would appear morally and biologically unwise, then, to tamper with the gene pool significantly without prior knowledge of the demands and needs of future environments.

Finally, many seriously doubt the efficacy of negative eugenic programs. Most deleterious genes are maintained in the population by normal heterozygous persons. It is estimated that "every individual is a carrier of three or more of such genes, and that virtually every human being carries at least one."[100] Since one cannot always be certain that such genes will manifest themselves clinically in present or future generations, "only by eliminating virtually everyone could our load of past mutations be eliminated, and this only temporarily, as new mutations are occurring all the time."[101]

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[99] Marc Lappe, "Moral Obligations and the Fallacies of 'Genetic Control,'" Theological Studies, Vol. 33, September 1972, p. 423.

[100] Arno G. Motulsky, George R. Fraser and Joseph Felsenstein, "Public Health and Long-Term Genetic Implications of Intrauterine Diagnosis and Selective Abortion," in Daniel Bergsma (ed.), Intrauterine Diagnosis (Birth Defects: Original Article Series, Vol. 7: The National Foundation - March of Dimes, April 1971), p. 26.

[101] Orlando J. Miller, "Discussion of Symposium Papers," Ibid., p. 34.

An alternative suggestion for improving the gene pool, without acting directly upon biological man, is to minimize or eliminate environmental hazards. It is becoming clear that "we are exposed to a wide range of chemical and physical agents which may damage the genetic material of our cells."[102] Thus, to the extent that man contaminates his environment and introduces factors that render it harmful, "his best interests are served by the adoption and enforcement of regulatory measures to prevent, minimize, or remove undesirable contamination."[103]

In view of the sometimes vehement stands taken by those on both sides of the argument, it would seem to be useful to begin to assess the status of the human gene pool. A six-year report of the American Eugenics Society speaks directly to this point:

> In view of the relative stability of the gene pool, the problem is not generally viewed as one requiring dramatic or 'crash' solutions. But in the long run, changes in the distribution and frequencies of genes may be of greatest significance. At this stage the need is for better identification of the present and potential direction of changes rather than action to alter these trends in any major way.[104]

It is also not too soon to begin to evaluate some of the suggested approaches for improving man's capability to control genetic disease.

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[102] Bloom, op. cit., supra, n. 31 at 1. See also V.E. Headings, op. cit., supra, n. 50.

[103] National Commission on Community Health Services, Changing Environmental Hazards, Report of the Task Force on Environmental Health (Public Affairs Press, Washington, D.C., 1967), p. 20.

[104] Theodosius Dobzhansky, Dudley Kirk, Otis Duncan and Carl Bajema, The American Eugenics Society, Inc. Six-Year Report, 1965-1970 (Published by the Society: New York), p. 6.

II. Prenatal Diagnosis and Selective Abortion

When prenatal diagnosis is combined with abortion, it becomes possible to alter directly the course of genetic disease. The introduction of new automated procedures will facilitate diagnosis as well as lessen its cost. It is likely, therefore, that as methods for intrauterine diagnosis improve, that pressures to use them in the management of the pregnant patient will increase.[105] Undoubtedly, this new technical capability will also add another dimension to the debate concerning abortion. It would be useful, therefore, to examine some of the criteria for developing policy for this alternative.

A. Risks/Benefits of Prenatal Diagnosis: One important consideration is the risks involved in using various prenatal diagnostic tests. All of the techniques described herein carry some degree of risk. While most of the evidence appears to indicate that the risk is minimal, much more data remains to be collected and evaluated. In the case of amniocentesis, for example, it has been suggested that "the current status of knowledge of the biology of amniotic fluid and its contents - including the fetus - is so rudimentary that this field must be regarded primarily as an area for research."[106] As noted earlier (*supra*, p. 7), very little information is available regarding the long-term risks of applying amniocentesis. Since the use of any diagnostic technique is justified only if the frequency of the disease or its severity

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[105] "As couples feel social pressure to limit population growth and to be content with only two children, most will very much want to ensure that the two they do have are healthy. I expect the demand for amniocentesis to develop strongly." C.O. Carter, "Practical Aspects of Early Diagnosis," in Maureen Harris (ed.), *Early Diagnosis of Human Genetic Defects: Scientific and Ethical Considerations*, Fogarty International Center Proceeding, No. 6, 1972. (Department of Health, Education and Welfare, Publication No. (NIH) 72-75), p. 20.

[106] Orlando J. Miller, *op. cit.*, *supra*, n. 101 at 33.

are greater than the risks posed by the diagnostic procedure, a careful assessment of those risks and the reliability of the diagnosis should be made.

Because of the danger of applying these techniques to the general population before their costs - in terms of morbidity and mortality to mother and fetus - have been reliably assessed, it has been suggested that they be used only when a couple carries a moderate or high risk of giving birth to a child with a genetic defect.[107] Various criteria for making such determinations have been proposed.[108] For example, statistics indicate that increasing age at pregnancy is correlated with an increased incidence of chromosomal abnormalities.[109] Thus, prospective prenatal diagnosis might be warranted of mothers above a certain age.[110]

As familiarity with these techniques increases, the risks will surely diminish. Automation will make the required tests simple and inexpensive and more couples will undoubtedly request them. Thus, by emphasizing the criterion of risks/benefits, there might well come a time when prenatal diagnosis will be an integral part of monitoring all pregnancies. There are, however, other considerations.

B. Parent-Child Relationship: Since treatment or cure is not available for most genetic deseases, the only therapeutic alternative following the

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[107] Michael M. Kaback, quoted in Maureen Harris (ed.), op. cit., supra, n. 105 at 85.

[108] C.O. Carter, Ibid., pp. 18-19.

[109] Luks and Ruddle, op. cit., supra, n. 9 at 495-497.

[110] In the case of Down's syndrome, for example, a substantial proportion - as high as 33 per cent - of children are born to mothers above the age of 40 years. Motulsky, et. al., op. cit., supra, n. 100 at 30.

diagnosis of a defective child is an abortion. Important to consider here is the effect that the wide-scale application of prenatal diagnosis combined with abortion will have on the parent-child relationship. Ethicist John Fletcher contends that

> the experience of parents in prenatal diagnosis and genetic counseling does not lessen the affection they bear for their children, already born or to be born, even though <u>that relationship is permanently altered by the character of the experience of genetic counseling and amniocentesis.</u>[111] (emphasis added)

In his efforts to identify and describe this "altered relationship,"[112] Fletcher suggests that a new stage of life is created, in which parents will be as intimate with their children before they are born as they are after they are born. One result of this was "that active roles as parents began earlier in the course of pregnancy . . . Assurance of the health of the child releases parental care, planning and symbolic activity usually reserved for birth.[113] Fletcher quotes a number of couples responding that "they loved them [their children] more because they had known them longer."[114] Ironically, Fletcher also found that this pre-natal intimacy "increases the sense of compulsion towards perfection that middle-class people have; they want their

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[111] John Fletcher, "The Brink: The Parent-Child Bond in the Genetic Revolution," <u>Theological Studies</u>, Vol. 33, September 1972, p. 428.

[112] <u>Ibid</u>., pp. 457-485. His sample consisted of 25 couples who had undergone amniocentesis and had given birth to a healthy child or had an abortion performed.

[113] <u>Ibid</u>., p. 477.

[114] Interview with Dr. John Fletcher, Director of Interfaith Metropolitan Theological Education, Inc., Washington, D.C., August 11, 1972.

babies to be healthy, beautiful and perfect."[115] He sees a danger in this, contending that "the drive towards perfection is one of the worst qualities that human beings have since it causes them to become very intolerant."[116]

Fletcher also asks if prenatal diagnosis,

> because it inclines the parents to contemplate the abortion of the fetus before they are fully informed as to the results of the test, erode[s] that "basic trust" which is so fundamental as to lead Erik Erikson to assert that "the firm establishment of enduring trust over basic mistrust is the first task of the budding personality and therefore first of all a task for maternal care"?[117]

Fletcher contends that even if the diagnostic results are negative, the test and its results are going to change the lives of the parents. "They will never be the same parents they were before because this test is changing the way they learn the roles of parenthood "[118] People have been brought up to love their child, at least prior to its birth, without preconditions. But, says Fletcher, "when you start contemplating the tests with the added feature that abortion is an alternative, you have introduced an element of doubt into that relationship that has never been there before. So you are a different parent than you were taught to be."[119] Thus, genetic technology has altered parenthood in a way that had not been anticipated.

What will be the effect of this new dimension of parenthood on the "basic

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[115] Idem.

[116] Idem.

[117] Fletcher, op. cit., supra, n. 111 at 473.

[118] Interview with John Fletcher, supra, n. 114

[119] Idem.

trust" between child(ren) and parents? Fletcher states that "nobody can live with the thought that his parents would have killed him if he had been sick. There is no way to accept that, yet you are going to have a whole generation of parents who have had this opportunity."[120] In the context of its present usage, Fletcher believes that prenatal diagnosis "does not introduce a permanently insoluble moral conflict in the ethics of parental caring."[121] But what will be its effect if applied on a wide-scale and supported by socially and legally sanctioned abortion? Fletcher believes that

> Nothing could weaken or dissolve the parent-child bond more effectively than children becoming afraid that the parents made such decisions for trivial reasons of personal convenience or because they were forced into it for external societal reasons.[122]

The parent-child relationship, then, constitutes another important variable to consider when developing genetic technology policy (see *infra*, pp. 63-64 , for additional discussion of intrafamily relationships).

C. Economic Variables: Economic factors must also be considered. The economic impact can be evaluated on two levels: (1) the burden which falls on the individual family, and (2) the costs to society. The birth of a genetically defective child creates new problems of resource allocation for a family. The cost of caring for such a child can make deep inroads into a family's financial

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[120] *Idem.* Fletcher also inquires into the feelings of living children, e.g. will they worry about their own security?, where amniocentesis was used on a fetal sibling. *Op. cit.*, *supra*, n. 111 at 478.

[121] Fletcher, *op. cit.*, *supra*, n. 111 at 479.

[122] *Ibid.*, p. 480.

resources (witness the case of cystic fibrosis, supra, p. 23) and private health insurance has been unable to absorb this impact. This drain on resources might also have disruptive consequences for the family unit in more subtle ways.[123]

The costs to society are both direct and indirect. Society not only assists in providing care for defective individuals, but also assumes the losses resulting from their inability to become economically and socially productive members of society. Institutionalization and care for persons with genetic disorders, many of which are chronic in nature, can be very expensive. For example, the cost to society of caring for those suffering from Down's syndrome, which has an estimated frequency of one in 600 births, is approximately $1.7 billion annually.[124] The economic impact of genetic disease, then, must be weighed along with other factors.

D. Abortion and the Gene Pool: While a program of selective abortion might help to relieve the emotional and financial strain experienced by individuals and their families, how effective would such a program be in reducing the total frequency of deleterious genes? Arno Motulsky and his colleagues have found that the use of selective abortion to reduce the cases of autosomal recessive diseases "will be relatively small (between 12.5% and 34%) if the procedure is only initiated following birth of an affected child."[125] In fact, selection against recessive genes under any conditions

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[123] See McCollum, op. cit., supra, n. 73 at 1335-40, for a discussion of some of the educational, social and psychological needs of other family members that might be compromised by the strain on family resources.

[124] Glass, op. cit., supra, n. 90 at 241.

[125] Motulsky, et. al., op. cit., supra, n. 100 at 59.

will be ineffective unless there is also selection against heterozygotes. For example, "a 50% reduction in reproduction of heterozygotes would reduce the incidence of the recessive homozygote under random mating to one fourth its former value in one generation."[126] For maximum effectiveness in eliminating autosomal recessive diseases, premarital carrier detection would be required to detect those matings at risk.[127]

Sex-linked diseases can be prevented by prenatal diagnosis of heterozygote mothers and selective abortion of all male fetuses. The impact of such a program, however, would be somewhat softened since many harmful sex-linked diseases are a result of fresh mutations. Thus, "even with prospective diagnosis, the maximum case reduction would not exceed two-thirds of existing affected males for diseases with zero fertility."[128] A potential dysgenic effect of such a program is that aborion of all male fetuses of heterozygote mothers would result in an increase (as much as 50 per cent with each generation in the case of hemophilia)[129] in female carriers in future generations, thus requiring more abortions.

The possibility that selection against autosomal recessive diseases would lead to an increase in their gene frequency could be the result of "reproductive compensation," since couples would be inclined to replace the affected child lost by abortion. A proportion of these compensating children

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[126] James F. Crow, "Rates of Genetic Change Under Selection," _Proceedings of the National Academy of Sciences of the U.S.A._, Vol. 59 March 1968, p.660.

[127] Motulsky, _et_. _al_., _op_. _cit_., _supra_, n. 100 at 30.

[128] _Ibid_., p. 31.

[129] Friedmann, _op_. _cit_., _supra_, n. 11 at 40.

will be abnormal gene carriers, thus increasing the frequency of abnormal genes over that which would have resulted had no such program been implemented. There is evidence, however, that "despite compensation, the total effects on gene frequency are minimal and are not a cause for concern."[130]

A program of selective abortion aimed at reducing the frequency of harmful genes raises a number of sensitive issues. For example, if a distinction between affected fetuses and clinically normal carriers cannot be made, as in the case of hemophilia, half of the male fetuses aborted would be normal. The moral implications of such a procedure must be weighed along with other considerations. A concomitant problem resulting from the inability to distinguish between affected and normal male fetuses _in utero_ is that the result would be a 75 per cent probability of abortion with each pregnancy. This would mean a "24% risk that five consecutive pregnancies would be aborted."[131] In this instance, then, the deleterious effect on the couple involved might be greater than if no such program were introduced.

As noted earlier, abortion of all male fetuses where sex-linked diseases are indicated would result in an increase in female carriers, thus increasing the frequency of the harmful gene and the need for abortion. Is there also justification for aborting female carriers? The abortion of such fetuses is morally questionable since they exhibit no clinical manifestation of the disease. From a population and public health point of view, a recent study found little evidence to support such a program.[132] Perhaps such carriers

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[130] Motulsky, _et_. _al_., _op_. _cit_., _supra_, n. 100 at 31.

[131] Michael M. Kaback, "Discussion of Symposium Papers," _Ibid_., p. 35.

[132] Motulsky, _et_. _al_., _op_. _cit_., _supra_, n. 103 at 27.

could be counseled not to reproduce; in this event, the moral and political overtones of such a policy need to be carefully assessed. Finally, there are those who believe that the development of new medical techniques for treating such diseases will make the abortion of such fetuses unnecessary.[133]

E. Attitudes and Policies on Abortion: Another factor which will influence the introduction and development of this approach involves existing attitudes and policies concerning abortion. In a study of 25 couples, Fletcher found that while "abortion is the major moral problem of parents in genetic counseling, [they] are inclined to favor abortion in case of a positive diagnosis, and they have reached this position prior to counseling."[134] On a much broader scale, a recent national survey found that majority support for legal abortion has increased sharply. The survey revealed that 64 per cent of all Americans support full liberalization of abortion laws, believing that "abortion should be a matter for decision solely between a woman and her physician."[135] Recent statements by both public and private groups also reflect a more liberal attitude toward abortion. For example, the Commission on Population Growth has recommended that "present state laws restricting abortion be liberalized along the lines of the New York statute [which, prior

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[133] Fritz Fuchs, quoted in Maureen Harris (ed.), op. cit., supra, n. 108 at 124-125. For example, ten years ago the chances were remote that a baby with Down's syndrome would live beyond its 15th birthday. Since that time, however, the development of new antibiotics has given such children a projected life expectancy of 50 years or more. See Joseph D. Whitaker, "Science Lends Hand to Mongoloid Baby," Washington Post, December 18, 1972, p. A1

[134] John Fletcher, "Moral Problems in Genetic Counseling," Pastoral Psychology, April 1972, p. 60.

[135] George Gallup, "Abortion Seen Up to Woman, Doctor," Washington Post, August 25, 1972, p. A2.

to the recent Supreme Court ruling, was the most liberal of the state abortion laws]."[136] And the World Council of Churches has called for its members

> to be prepared to endorse the personal right of parents to choose an induced abortion to prevent the birth of a gravely defective child. Wherever the laws of the state make this illegal, the churches should press for a modification of the law to permit such options to take place.[137]

The possibility of using therapeutic abortions for genetic purposes raises concern among many who fear that in a social climate in which unwanted preganancy is sufficient indication for abortion, there will be a tendency for couples to seek abortions for arbitrary and casual reasons.

> With increasing acceptance of abortion and limitations on family size, it is probable that some families will seek termination of pregnancies that involve less severely affected fetuses, or those with disorders that are treatable to some extent . . . . It is also likely that abortion may be chosen for disorders of uncertain severity. It can in fact be anticipated that families will not want to risk any departure from the normal karyotype in their offspring.[138]

Perhaps it is appropriate to recall Fletcher's fears regarding the possible growth in intolerance on the part of future parents (<u>supra</u>, pp. 36-37). Those who fear the emergence of an "abortion mentality," characterized by an increasing intolerance for "weakness" or differentiation from a given "norm,"

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[136] The Report of the Commission on Population Growth and the American Future, <u>Population and the American Future</u>, (U.S. Government Printing Office: Washington, D.C., March 1972), p. 142.

[137] Working Committee on Church and Society, <u>op</u>. <u>cit</u>., <u>supra</u>, n. 4 at 6.

[138] Aubrey Milunsky, John W. Littlefield, Julian N. Kanfer, Edwin H. Kolodny, Vivian E. Shih and Leonard Atkins, "Prenatal Genetic Diagnosis (Third of Three Parts)," <u>The New England Journal of Medicine</u>, Vol. 283, December 31, 1970, p. 1502. The authors cite the XYY chromosome anomaly as a disorder of "uncertain severity." The varied scientific opinion regarding this genetic defect and its consequent policy implications will be discussed later.

point to an almost casual acceptance of abortion. This attitude, they maintain, is reflected in statistics from those states which had liberal abortion laws and in the growing acceptance of "early-stage abortion," which allows a woman with a suspected and unwanted pregnancy simply to have her monthly menstrual period extracted.[139] This concern over the effect of a program combining prenatal diagnosis with selective abortion may be expressed as important questions for policy: Do acceptable standards for deciding when to abort need to be established? Whose responsibility is it to develop and apply those standards? What will be the effect of such a program on attitudes toward already existing "genetically defective" children?

F. Policy Alternatives: Debate has already begun regarding the types of policy adjustments that might be made. For example, should a woman be required to agree to an abortion prior to prenatal diagnosis? Some contend that "For parents unwilling to take that step, diagnosis of a disease in a fetus would serve no useful purpose and would only create anxiety and grief for the parents."[140] Thus, they firmly believe that "the decision to interrupt the preganacy, if the suspected disorder is verified in the fetus, should be made before the amniocentesis."[141] Should there be special provisions, however, for those patients or physicians whose religious convictions preclude an

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[139] For details of the procedure and some of its problems, see Time, September 11, 1972, p. 47; also the Washington Post, January 26, 1973, p. C5.

[140] Arno G. Motulsky, "Genetic Therapy: A Clinical Geneticist's Response," in Michael Hamilton (ed.), op. cit., supra, n. 86 at 131.

[141] Fritz Fuchs, "Amniocentesis and Abortion: Methods and Risks," op. cit., supra, n. 100 at 19.

abortion under any circumstances?[142] There are others who find unacceptable such restrictions on individual decision-making. The use of prenatal diagnosis does not mean that "the geneticist may abrogate the couple's decision by assuming that if the fetus is normal she will carry it, or if abnormal, she will abort. The genetic component is one of many, and the client must be helped to put it in perspective for a positive choice."[143]

With respect to the difficult problem of deciding how "abnormal" a fetus must be to justify abortion, one geneticist has suggested that society must take advantage of "all morally acceptable developments that promise to minimize the number of unfortunate individuals incapable of full participation in this complex society."[144] While this position might attract sympathy, it would probably draw an equal amount of skeptical criticism. How is one to determine if a fetus will be "incapable of full participation"? This is a very real problem, amply illustrated by the case of Down's syndrome

> Some Down's children have rather gross retardation, major heart anomalies, and many fail to survive infancy; on the other hand, some have a rather mild retardation . . . no major heart defects, and have lived to at least middle age. An individual carrying a gene or genes which cause

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[142] Of relevance here is a resolution (S.J. Res. 64) recently introduced by Senator Frank Church, which would make it national policy, in the administration of all Federal programs, to protect physicians and health care personnel in their exercise of religious or philosophical beliefs which proscribe the performance of abortions or sterilization procedures. Congressional Record, February 15, 1973, pp. S2567-68.

[143] E. James Lieberman, "Psychological Aspects of Selective Abortion," Ibid., p. 20.

[144] James V. Neel, "Lessons from a 'Primitive People,'" Science, Vol. 170 November 20, 1970, pp. 820-21.

> retardation may be more or less retarded depending on other genetic factors and the external environment which is at work.[145]

Furthermore, many Down's children have been found not to suffer and to have good emotional adjustment.[146] Thus, it would be difficult to determine an absolute measure of biological fitness, since such fitness is to some extent dependent on a particular environment.

A policy question which pervades all others concerns the basis upon which society will allocate decisions to either personal conscience or public choice. At what point is society's intervention into individual decision-making justified? As prenatal diagnosis becomes more widespread, the tensions resulting from its application will become more acute. There is a need to relieve those tensions, balancing individual and societal needs with the proper respect for human life.

III. Screening for Genetic Disease

If prenatal diagnosis and selective abortion were combined with screening programs designed to detect heterozygous carriers, it might be possible to realize significant reductions in the incidence of some recessive diseases. If at-risk parents were identified prior to reproduction, they could eliminate the risk by remaining childless, by adopting their family, or, when available, by artificial insemination or prenatal diagnosis. Another advantage of such programs is that the detection of the homozygous child after birth might be followed by immediate treatment, thus reducing and perhaps eliminating the deleterious effects of the disease.

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[145] Rober' C. Baumiller, "XYY Chromosome Genetics," Journal of Forensic Sciences, Vc . 14, October 1969, p. 417.

[146] Karen Lebacqz, Letter to the Editor, The Hastings Center Report, Vol. 2, February 1972, pp. 12-13.

A. Cost/Benefits of Screening: Cost/benefit analysis has shown that screening programs would result in large savings for both the family and society. For example,

> The cost for successful medical treatment of phenylketonuria is estimated to be no more than one tenth the cost of care for a retarded patient in an institution. Early diagnosis and treatment thus saves the community about $9,000 annually per patient. Moreover, the patient who escapes the immediate consequences of this mutant allele will eventually earn income and pay taxes, representing a further benefit to the community.[147]

In the case of detection prior to birth, a recent study demonstrated that in the case of cystic fibrosis, a substantially favorable economic ratio would result.[148] As new screening techniques become available an important part of planning large-scale screening programs should be the assessment of the costs involved in treating the genetic diseases. Present evidence seems to indicate a substantial economic saving.

B. Screening and the Gene Pool: Another important criteria for assessing the value of screening is its potential for reducing the frequency of deleterious genes. The underlying assumption of such a program is that heterozygous couples will not mate, or in instances where they do, they will not have their own children. It has been suggested that this latter alternative is best realized through a program of voluntary sterilization. It should be useful, therefore, to review the potential impact of these two approaches on the gene pool.

If the fertility of heterozygotes and normal individuals were identical,

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[147] Charles R. Scriver, "Screening for Inherited Traits: Perspectives," in Maureen Harris (ed.), op. cit., supra, n. 105 at 95-96.

[148] Motulsky, et. al., op. cit., supra, n. 100 at 30.

the frequency of the abnormal gene would remain constant. However, many genes which result in autosomal recessive diseases owe their high frequency to the heterozygote's advantage in fertility or mortality. If heterozygotes were to cease mating with one another and this advantage persisted, there would be an increase in the genes since heterozygotes would have a greater average number of children. Consequently, the

> gene loss previously incurred by infertility or early death in homozygotes would cease. In the case of cystic fibrosis persistence of the assumed heterozygote advantage for about 100 generations would increase the frequency of carriers in white populations from 5% (its present level) to 50%.[149]

If there were little or no difference in fertility between heterozygotes and normal persons, as might be the case if family size became more standardized, a system in which heterozygotes avoided marriage would prevent a decrease in abnormal gene frequency. There might even be a slow increase due to fresh mutations, though several thousand generations would pass before the frequency of carriers would be doubled.[150]

Sterilization of heterozygous carriers appears unlikely to have any substantial impact on reducing deleterious genes. If the program were compulsory, it would require 1,500 years to reduce the frequency of a particular recessive gene by half.[151] If sterilization is undertaken on a voluntary basis, the rate of decrease would be much less. Thus, the elimination of a recessive defect by sterilization is a very slow process and probably of no immediate

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[149] Ibid., p. 28.

[150] Ibid.

[151] Ching Chun Li, Population Genetics, (The University of Chicago Press: Chicago, 1955), p. 253.

value in eugenic programs.

C. Voluntary versus Compulsory Screening: Genetic screening raises other essential policy issues. One crucial and heavily debated issue concerns the nature of such programs: Should participation in screening programs be voluntary or be made compulsory? The controversy over this question has turned into a full-fledged debate. At least ten states[152] and the District of Columbia have enacted screening programs which will either require, or at the discretion of a doctor or health officer may require, black persons to undergo tests for sickle-cell anemia. There is little disagreement about the desirability of such tests if they are voluntary, but when the tests are made mandatory, the debate becomes vigorous.

The City Councilman who introduced the compulsory sickle-cell anemia legislation in the District of Columbia defends his position, contending that "this is a trait and a disease that has been ignored. There is no cure, but a family knowing the facts would know what counseling or steps to take . . . I don't think we can get at the problem on a voluntary basis. There is too much apathy."[153] On the other side of the debate, there are many persons who find mandatory programs both unnecessary and counter-productive. A recent genetics task force of the Institute of Society, Ethics, and the Life Sciences strongly urged that

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[152]The ten states are: Georgia, Illinois, Indiana, Iowa, Kentucky, Louisiana, Maryland, Massachusetts, New York and Virginia. At least four of these states - Maryland, Massachusetts, New York, Virginia - and the District of Columbia will consider legislation in 1973 to repeal the compulsory features of their programs.

[153]Henry S. Robinson, quoted in Victor Cohn, "Disease Publicity Raises Problems." Washington Post, November 12, 1972, p. A12.

> genetic screening programs should be conducted on a voluntary basis . . . . There is currently no public-health justification for mandatory screening for the prevention of genetic disease. The conditions being tested for in screening programs are neither "contagious" nor, for the most part, susceptible to treatment at present.[154]

It is also feared that state enforced screening programs will be the beginning of greater government intervention into what many consider to be an area for private decision-making.

> When you start talking about compulsory testing, you also start talking about compulsory genetic counseling. When you start talking about compulsory genetic counseling, you start talking about putting the state behind it. Then you get into all sorts of implications . . . . I'm for voluntary sickle trait testing, but I believe compulsory genetic testing sets a bad precedent in our kind of society.[155]

The possible implications of compulsory counseling might include state-supported marriage and sterilization laws for genetic purposes, the precedents for which already exist. In fact, 25 states still retain eugenic sterilization statutes, 22 of which are compulsory.[156] There are also state laws prohibiting

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[154] A report from the Research Group on Ethical, Social and Legal Issues in Genetic Counseling and Genetic Engineering of the Institute of Society, Ethics and the Life Sciences, "Ethical and Social Issues in Screening for Genetic Disease," The New England Journal of Medicine, Vol. 286, May 25, 1972, pp. 1130-31. In the case of sickle-cell anemia there is no acceptable and effective treatment at this time. See R.B. Scott, "Urea Therapy in Sickle-Cell Anemia," The New England Journal of Medicine, 285: 1025-26, October 28, 1971.

[155] Paul McCurdy, Georgetown University, quoted in Victor Cohn, op. cit., supra, n. 153.

[156] William R. Matoush, "Eugenic Sterilization - A Scientific Analysis," Denver Law Journal, Vol. 46, 1969, p. 633. In recent years, however, these laws have not been enforced.

consanguinous marriages, most prohibiting marriage between first cousins or persons more closely related.[157] Might not the same legal rationale which led to these laws also be used to justify their application to carriers of deleterious genes?[158] While a definitive answer is not possible at this time, there is some speculation that all such laws might be declared unconstitutional. In Griswold v. Connecticut,[159] the Supreme Court held that the state has no power to interfere with the use of contraceptives by married couples, such use being considered one of the rights reserved to the people under the Ninth Amendment. If one interprets the case broadly, it may be read "to affirm that the decision by a husband and wife to have children, or not to have children, or how many children to have, is one in which the state may not interfere, whether the purpose be to limit the population or to improve it eugenically."[160] Underlying this reasoning are certain assumptions regarding the "rights" of couples to reproduce.

D. Procreation and Genetic Disease: If procreation is viewed as a couple's "right," then it should be useful for planning genetic counseling activities and services to have some feeling for the kinds of reproductive decisions that couples will make and the reasons for their decisions. Ramsey

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[157] Michael Farrow and Richard Juberg, "Genetics and Laws 'Prohibiting' Marriage in the United States," Journal of the American Medical Association, 209: 535-538, July 28, 1969.

[158] In this regard it is interesting to note that Virginia's law also requires sickle-cell screening for marriage license applicants. Virginia Code, section 32-112.14

[159] 381 U.S. 479 (1965).

[160] Frank P. Grad, "Legislative Responses to the New Biology: Limits and Possibilities," UCLA Law Review, Vol. 15, February 1968, p. 488.

finds it "shocking to learn . . . how many parents will accept grave risk of having defective children rather than remain childless."[161] Unfortunately, there are only a few empirical studies concerning the tendency toward risk-taking among couples and the results are somewhat mixed. In his study of 25 couples, Fletcher found that "Given the choice of accepting a genetically defective child or resorting to abortion, . . . they would choose the latter."[162] Another study involving 455 couples found that "on the whole, they took responsible decisions on the basis of the information. Where the recurrence risk was high - that is, equal to or greater than 1 in 10 - two-thirds (109 out of 170) were deterred from planning further children."[163] In his study at Yale, Hsia reports that only 25 per cent of the couples in a high risk group were deterred by counseling.[164] And in their study of 76 families, Leonard and his colleagues report that 34 (45 per cent) stated that "They regarded the disease as a reason for curtailing reproduction."[165] Finally,

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[161] Ramsey, op. cit., supra, n. 89 at 166.

[162] Fletcher, op. cit., supra, n. 134 at 53-54.

[163] C.O. Carter, K.A. Evans, J.A. Fraser-Roberts and A.R. Buck, "Genetic Clinic: A Follow-Up," Lancet, Vol. 1, February 6, 1971, p. 281. Both this and the Fletcher studies may be somewhat biased due to the character of the sample populations. The majority of the Fletcher sample was middle-class and has a graduate degree, while the Carter, et. al., sample over-represented the upper social classes and was probably above average in education.

[164] Y.E. Hsia, "Choosing My Children's Genes," Paper presented at the American Association for the Advancement of Science annual meeting, Washington, D.C., December 29, 1972.

[165] Claire O. Leonard, Gary A. Chase and Barton Childs, "Genetic Counseling: A Consumer's View," The New England Journal of Medicine, Vol. 287, August 31, 1972, p. 435. This study focused on parents of children with three types of genetic diseases: cystic fibrosis, phenylketonuria, and Down's syndrome.

the results of a follow-up study[166] in England of 53 women referred for genetic counseling in families with Duchenne muscular dystrophy (a sex-linked disease for which there is no treatment) can be summarized as follows: Of the 41 women at high risk (defined as greater than 1 in 10), 36 decided to have no further children and two decided upon selective abortion. Only two disregarded the risks and intentionally became pregnant. Of the five women at medium risk (1 in 10 to 1 in 20), only one planned to have further children. The others considered the risks too great. Of the seven women at low risk (less than 1 in 20) only one was not reassured by the low risks and has avoided pregnancy.[167]

It should be pointed out that in most cases these studies refer to the impact of genetic counseling on couples' reproductive intentions, not their observed reproductive behavior. Generally speaking, these data suggest that counseling can have a significant impact on reproductive attitudes. The findings regarding actual reproductive behavior are not so encouraging. In the largest of the aforementioned studies, Carter and his colleagues report that of those high-risk couples who stated that they were attitudinally deterred from having further children, 24 per cent (26 out of 109) had at least one additional pregnancy. Among the low-risk couples, who also claimed to be attitudinally deterred, 15 per cent (9 out of 60) had at least one

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[166] A.E.H. Emery, M.S. Watt and E.R. Clack, "The Effects of Genetic Counselling in Duchenne Muscular Dystrophy," Clinical Genetics, 3:147-150, 1972. The investigators report that all social classes were represented and that their distribution was similar to that of the general population.

[167] Ibid., pp. 148 and 149.

additional pregnancy.[168] At least in this particular study, there appears to be a considerable degree of difference between the impact of genetic counseling on reproductive attitudes and its impact on actual reproductive behavior. There is an obvious need for more systematic investigation into the question of risk-taking as well as for determining those factors which influence such reproductive decisions. James R. Sorenson has identified some of these factors: "(1) the size of the risk, (2) the severity of the potential abnormality, (3) the social and private attitudes of the parents toward abnormality, (4) the economic capacity of the family to endure the burden of a genetic disease, (5) the genetic health of existing children, and (6) the type of counseling parents receive."[169] But as he points out, there is little data concerning the specific role that each of these factors (and perhaps other factors as well) plays in parental decision-making.

There is no consensus, however, that there is, or should be, a "right to procreation." Ramsey believes that

> If the fact situation disclosed by the science of genetics can prove that a given person cannot be the progenitor of healthy individuals (or at least not unduly defective individuals) in the next generations, then such a person's "right to have children" becomes his duty not to do so, or to have fewer children than he might want (since he never had any right to have children simply for his own sake).[170]

Thus, Ramsey calls for the development and adoption of an "ethics of genetic

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[168] Carter, et. al., op. cit., supra, n. 163 at 283.

[169] James R. Sorenson, "Social Aspects of Applied Human Genetics," Social Science Frontiers, 1971, No. 3, Copyright (c) 1971 by Russell Sage Foundation, New York, p. 13.

[170] Ramsey, op. cit., supra, n. 87 at 35.

duty," whereby couples act responsibly and morally in order to prevent the birth of a defective child. Joseph Fletcher suggests that a more appropriate guideline for developing policy is "needs." He explains that

> Needs are the moral stabilizers, not rights . . . . If human rights conflict with human needs, let needs prevail. If medical care can use genetic controls preventively to protect people from disease or deformity, or to ameliorate such things, then let so-called "rights" to be born step aside.
>
> Rights are nothing but a formal recognition by society of certain human needs, and as needs change with changing conditions so rights should change too. The right to conceive and bear children has to stop short of knowingly making crippled children - and genetics gives us that knowledge . . .[171]

To what extent the state should be the agent for balancing the genetic "rights" and "needs" of its people is a question that society may soon have to face. There may be a fine line between a particular genetic defect being reason for a couple to refrain from procreation and its being reason for compulsory restrictions on the part of the state.

E. Target Populations: The nature of the program also raises questions concerning the populations toward which such programs should be targeted. The programs aimed at sickle-cell anemia clearly demonstrate the problems involved. These programs, and their enacting legislation, represent the nation's first genetic effort directed at a particular race.[172] While many other groups experience a high incidence of genetic disease, e.g. the Ashknazi

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[171] Joseph Fletcher, "Ethical Aspects of Genetic Conrols: Designed Genetic Changes in Man," The New England Journal of Medicine, Vol. 285, September 30, 1972, p. 782.

[172] Sickle-cell anemia, with a frequency of 1 in 400, is the most common genetic disease in the black population. The incidence among the white population is much smaller. See Victor Cohn, "Disease's Effects Often Exaggerated," Washington Post, November 13, 1972, p. A8.

Jews and Tay-Sachs disease, and those of Mediterranian ancestry and Cooley's Anemia, none has been singled out for compulsory testing. The problem with isolating a specific ethnic group is that it might be interpreted as a racist gesture. Such has been the case with sickle-cell anemia, with some comparing it to the "racist eugenics legislation that led to the final solution in Nazi Germany,"[173] and others viewing it, when combined with some forms of genetic counseling, as "white genocide."[174] Whether or not these criticisms are valid, they are one reason for the growing opposition among blacks to sickle-cell programs. And yet, without their involvement and cooperation it is unlikely that such programs can accomplish their aims.

There is also criticism of laws such as those in Virginia, which require the screening of persons in correctional institutions and state mental hospitals. Some question the intent of such laws, maintaining that there is

> no valid reason why prisoners and mental patients should be tested . . . the potential for mischief is great . . . scientific knowledge has in the past been perverted to fulfill social ends, and there is, unfortunately, nothing . . . which would lead one to believe there is no basis for alarm.[175]

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[173] James E. Bowman, Director of Laboratories, University of Chicago, quoted in Victor Cohn, op. cit., supra, n. 153.

[174] Victor Cohn, "Sickle-Cell Project Outlined," Washington Post, July 21, 1972, p. A15. A recent study reports a direct "relationship between fears of racial genocide and the use of family planning methods." The investigators note the depth and source of this fear, writing that Negroes are "responding to a long history of every possible type of oppression which has been perpetrated against blacks. The resistance to family planning and to family planning agencies run by whites is merely a symptom of the deep sense of historical and life-long estrangement." William Darity and Castellano Turner, "Family Planning, Race Consciousness and the Fear of Race Genocide," The American Journal of Public Health, Vol. 62, November 1972, pp. 1458-59.

[175] Bowman, quoted in Victor Cohn, op. cit., supra, n. 153.

Another concern for screening legislation is the age at which persons should be screened. For example, the District of Columbia requires that "Each child admitted to a public school, either kindergarten or the first grade as the case may be, shall have been tested for sickle-cell anemia."[176] There are many, however, who believe that testing at such an early age is of dubious value and probably undesirable. They argue that these children "are too young to fully understand the implications of being a trait carrier, could suffer from the stigma, and may forget all about it by the time they are likely to be considering marriage and child-bearing."[177] Much more data needs to be collected regarding the "best time" at which to initiate such testing.

F. Program Design and Management: Another broad policy concern is the implementation and administration of screening programs. It is essential that screening programs be designed for the purpose of attaining one or more predetermined goals. Establishing clearly defined goals will help to avoid circumstances which might be costly in both scientific and human terms. A recent report suggests that the most important goals of a screening program are those that

> either contribute to improving the health of persons who suffer from genetic disorders, or allow carriers for a given variant gene to make informed choices regarding reproduction, or move toward alleviating the anxieties of families and communities faced with the prospect of serious genetic disease.[178]

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[176] Regulation No. 72-9, section 2 (May 5, 1972).

[177] B.J. Culliton, "Sickle-Cell Anemia: National Program Raises Problems As Well As Hopes," Science, Vol. 178, October 20, 1972, p. 284. Also, E. Beutler, D.R. Boggs, P. Heller, A. Maurer, A.G. Motulsky, and T.W. Sheehy, "Hazards of Indiscriminate Screening for Sickling," The New England Journal of Medicine, 285: 1485-86, December 23, 1971.

[178] Institute of Society, Ethics and the Life Sciences, op. cit., supra, n. 154 at 1129.

Another reason for establishing goals is to assist in program evaluation. If screening programs are to compete successfully with other programs for resource allocation, it will be necessary to provide "proof" of their effectiveness in order to justify public support. Identifiable goals are clearly needed for such evaluation. "Evaluation cannot exist in a vacuum. One must always ask evaluation 'of what.' Every action, every program has some value for some purpose."[179] Thus, an important task for program planners and administrators will be to develop appropriate measures and techniques for evaluating their efforts.[180]

The design and operation of screening programs raises other important considerations for policy-makers. One general observation concerns the relationship between public programs such as genetic screening and the communities to be served. Citizen pressure is becoming more influential in determining what services the community will receive. Suchman writes that

> Once sufficient evidence has accumulated to indicate the potential benefits of a program, the public is likely to demand the program without waiting for conclusive proof. The greater the need, the stronger the pressure to put the program into operation as soon as it begins to look successful.
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> Thus, "popular causes" spring up which bring pressure upon the program administrator to satisfy public demand regardless of professional judgment or evaluation findings.[181]

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[179] Edward A. Suchman, Evaluative Research: Principles and Practice in Public Service and Social Action Programs, (Russell Sage Foundation: New York, 1967), pp. 37-38.

[180] For a relevant discussion of the needs and problems of program evaluation, see Suchman, Ibid., especially chapters 6-8; Aaron Wildavsky, "The Self-Evaluating Organization," Public Administration Review, 32:509-520, September/October 1972; and Thomas A. Morehouse, "Program Evaluation: Social Research Versus Public Policy," Ibid., 32:868-874, November/December 1972.

[181] Suchman, op. cit., supra, n. 179 at 153 and 152.

The difficulties involved are illustrated by the history of PKU legislation, in which "a small group of determined and highly motivated parents of mentally retarded children, together with a few equally dedicated physicians, needed less than three years to persuade forty-one states to pass laws requiring the testing of newborn children for phenylketonuria . . . ."[182] This effort has been characterized as "a simplified and incomplete understanding of the objective situation, a singleminded campaign which trumpeted success and ignored failures, and most of all a failure to consider the harm that might be done by seeking to do good."[183] The result has been a "poor piece of legislation, one with noble aims, but based upon unwarranted medical assumptions."[184] If the circumstances surrounding the evolution of PKU legislation are studied carefully, it may be possible to avoid similar pitfalls in planning future screening programs.[185]

G. Screening Tests: Extra care must be taken to develop testing procedures that will be accurate and subject to a minimum latitude of interpretation. A problem which might develop as a result of unreliable testing methods is that a "high proportion of false negatives or false positives not only will cast suspicion and discredit on the method, . . . but may result in professional

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[182] Bessman and Swazey, op. cit., supra, n. 47 at 49.

[183] Ibid., p. 50.

[184] American Academy of Pediatrics, "New Child Health Legislative Bills Proposed - Academy Subcommittee Issues Guidelines," quoted in Bessman and Swazey, Ibid., P. 72.

[185] History may already be repeating itself. There are cries that a new kind of "sickle-cell crisis," one due to hastely drawn and poorly-planned sickle-cell legislation, is occurring. See Cohn, op. cit., supra, n. 153 at A1.

malpractice charges . . . ."[186] The case of PKU illustrates this problem as well as more serious consequences.

> Laboratory tests do not detect PKU but rather high blood phenylalanine levels, which can have causes other than PKU. Furthermore, the tests suitable for the mass screening required by law are subject to misinterpretation and error.
>
> The tests are not accurate; they miss a number of cases of PKU and yield false positive reactions in an even greater number. Given a positive test, the physician will very probably put the child on a low phenylalanine diet . . . But a child who does not have PKU is actively endangered by the diet and can suffer physical deterioration at the least; a number of children have died from being treated for PKU, and it is likely that they did not have the disease.[187]

While it may be claimed that the physician is still able to decide the appropriate course of treatment for an infant, the fact that such legislation is a matter of public policy exerts a "powerful stimulus to prescribe in accordance with the cultural mores"[188] and, in the case of PKU, has resulted in the use of an unproven treatment. Reliable testing procedures, therefore, are necessary both to assure proper treatment and to gain the confidence and cooperation of the community.

H. Screening Services and Delivery: There is also the question of what services should be included in the designing of screening programs. At a minimum, such services should include follow-up diagnosis, treatment and

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[186] Irving Ladimer, "Legal Consideration in Screening, Treatment, Counseling and Research in Sickle Cell Disease," Paper presented at a Symposium on Sickle Cell Disease, New York, November 19, 1971, pp. 7-8.

[187] Bessman and Swazey, op. cit., supra, n. 47 at 50-51.

[188] Joseph D. Cooper, "The Role of Government Legislation in Management of Problems in Medicine," in Anderson and Swaiman (eds.), op. cit., supra, n. 46 at 170. Bessman and Swazey report that there have been at least "half a dozen malpractice suits involving PKU." Op. cit., supra, n. 47 at 72.

genetic counseling. Some geneticists contend that

> It is probably unjustified on ethical grounds to mount large-scale screening programs for disease or carrier detection in conditions where the patient and carriers cannot be offered specific effective medical therapeutic alternatives, including intrauterine diagnosis and abortion.[189]

This reference to abortion raises sensitive policy questions, including whether or not public funds should be used to provide abortion services. If society's resources are expended in order to provide families with information that is required for intelligent reproductive decision-making, can it then deny them the option to implement their decision, an abortion being one option they might choose?

Genetic counseling also has an important role to play in screening programs. First, it can provide couples with the basic genetic information required to make informed and intelligent decisions about subsequent pregnancies. And second, it provides the follow-up support needed to help those couples implement their decisions.

In providing information to couples, the genetic counselor will be able to explain the source and meaning of a particular defect and, after appropriate testing and analysis, inform them of the risk of its occurrence or recurrence. The lack of such information might lead to poor decision-making in either of two directions. Some couples might have additional children when the probability is high that their future offspring will be adversely affected. Or, conversely, couples with conditions in which the risk is very low may

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[189] Robert F. Murray, Jr., "Problems Behind the Promise: Ethical Issues in Mass Genetic Screening," The Hastings Center Report, Vol. 2, April 1972, p. 13.

have no further children as a consequence of unreasonable fear. A recent study of families with genetically-ill children found that

> regardless of socio-economic class, birth order of the chronically ill child, religion, burden of care, and the heriditary nature of the condition, families continue to have children, whether purposefully or unplanned as do the parents of normal children. There is a strong indication, however, that this would not be the case if parents were aware of the risk involved in the transmission of genetic defects and if this information were coupled with knowledge of effective techniques to prevent pregnancy.[190]

Thus, the proper transmission of genetic information to couples might help them in planning their future families.

On a second level, counseling is needed to help couples adjust to and implement their reproductive decisions. A few examples drawn from case studies provide some insight into the various demands that would call for follow-up counseling. Fletcher studied the period of time following amniocentesis and found

> the parents in considerable anxiety, and whatever problems existed in their marriage or family relationships were exacerbated . . . . If a marriage is troubled, the strains will most likely break forth in this period, testing to the limits the capacity of the couple to face their problem and make plans . . . . Counselors should be particularly attentive to the deeper personal problems which emerge in this period.[191]

Fletcher describes existing counseling centers as poorly set-up to deal with these problems, noting that perhaps "one in twenty-five centers would be sensitive to marital problems and fewer than that would have the means to help people."[192] He also found couples in "need for support and counseling

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[190] Harry Sultz, Edward Schlesinger and Joseph Feldman, "An Epidemiologic Justification for Genetic Counseling in Family Planning," The American Journal of Public Health, Vol. 62, November 1972, p. 1492.

[191] Fletcher, op. cit., supra, n. 134 at 56.

[192] Interview with John Fletcher, supra, n. 114.

at the time of therapeutic abortion and the deep depression suffered at the time."[193] Unfortunately, he notes that abortion counseling facilities are less than adequate for the task.

Counseling might also be required to follow up on the initial diagnostic tests. It is important to consider the total health needs of the patient and, to use the case of PKU, neglect of such needs regarding the dietary problems might result in more serious physical and emotional problems.

> When treatment of a child involves restrictions in diet, it has broad implications for the entire family. How the parents feel about food, how much they use food as a weapon in the parent-child relationship, and how the other children in the home react, can mean the success or failure of the dietary regime. Consideration of the child as a member of a family that has many other responsibilities requires that medicinal and dietary care be obtainable without undue drain on family resources.[194]

There is need to assure, then, that any intervention into the genetic decision-making process will not be more injurious to the individual and/or his family than if such intervention had not occurred.

Counseling support might also help couples overcome the severe guilt feelings which often accompany the birth of an affected child. In the case of hemophilia, for example

> there is a need to deal with the emotional upset that occurs - the shock at the discovery, the guilt and the self-blame which comes from the inevitable feeling that parents are somehow responsible for causing the disorder and the fears as to what hemophilia entails.

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[193] Fletcher, _op_. _cit_., _supra_, n. 134 at 51.

[194] _Recommended Guidelines for PKU Programs for the Newborn_, (U.S. Department of Health, Education and Welfare, Health Services and Mental Health Administration, 1971), Public Health Service Publication No. 2160, p. 9.

> Helping the family through the upset is, of course, important in its own right, but it is also necessary for treatment purposes. Until the emotional problems are handled, it is very likely that the therapeutic efforts which require education of the parents about the reality of hemophilia will be hampered.[195]

Family follow-ups and counseling, therefore, might provide both the parents and the affected child with more effective genetic guidance.

A commitment to create such counseling services also entails the responsibility to ensure that the services reach prospective consumers. In his study of 250 counseling units, Sorenson found 25 per cent located in a hospital setting. He contends that

> Hospital based medical genetics will probably increase significantly as the impact of the various intrauterine diagnostic procedures become more accepted . . . . Today, with various forms of heterozygosity detection possible, as well as amniocentesis, there is an increasing need for the delivery of medical genetics to be associated with the facilities of a hospital and laboratory.[196]

This setting, according to Sorenson, will not only permit the maintenance of adequate facilities, but will most likely increase "the proportion of lower

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[195] Lee Salk, M. Hilgartner and B. Granick, "The Psycho-Social Impact of Hemophilia on the Patient and His Family," Social Science and Medicine, Vol. 6, August 1972, p. 503. In the same article (p. 496), the investigators report that in "14 of the 25 cases, there appears to be a clear-cut deleterious impact, e.g. contributing to the breakup of the marriage or most leading to a psychological withdrawal by the husband from family relationships." For further evidence highlighting the presence and impact of parental guilt, see David G. Langsley, "Psychology of a Doomed Family," American Journal of Psychotherapy, 15:531-538, 1961; and Simon Olshansky, "Chronic Sorrow: A Response to Having a Mentally Defective Child," Social Casework, 43:190-193, April 1962.

[196] James A. Sorenson, "Sociological and Psychological Factors in Applied Human Genetics," Department of Sociology, Princeton University, October 1971, pp. 14 and 15.

socio-economic groups receiving counseling."[197]

Consideration should also be given to the nature of the delivery mechanism.

> A prime requirement for any mechanism we devise to deliver service is that it be sufficiently flexible so that we can individualize the service package to fit in not only with abilities and peculiarities of the agents who are dispensing service but also with the individual differences of the consumers who receive them, and the communities and settings in which such services are provided and utilized.[198]

The importance of this point can be sufficiently demonstrated by the recent attempts of the National Institutes of Health to promote an employee sickle-cell testing campaign. The program was cancelled; one of the major reasons given for this was that it was "not organized by blacks with black feelings in mind."[199] The Institute of Society, Ethics and the Life Sciences has recommended that "From the outset program planners should involve the communities affected by screening in formulating program design and objectives, in administering the actual operations of the program, and in reviewing results."[200]

I. Screening Facilities and Organization: The provision of adequate and functional diagnostic facilities must also receive high priority from program planners. For maximum quality control and personnel expertise, testing should probably be done in regionally centralized laboratories so that costs can be minimized and the training of qualified personnel more easily accomplished.

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[197] Sorenson, _op_. _cit_., _supra_, n. 169.

[198] Rudolph Hormuth, "Organization of Community Services in Phenylketonuria," in Anderson and Swaiman (eds.), _op_. _cit_., _supra_, n. 46 at 165.

[199] Victor Cohn, "Black Health Care Lag Cited," _Washington Post_, November 15, 1972, p. A12.

[200] _Op_. _cit_., _supra_, n. 154 at 1130.

Because "biochemical assays necessitate facilities that often are well beyond the means of the average clinical laboratory, [it] simply is not feasible for one laboratory to perform all of the tests now possible . . ."[201] Thus,

> A screening program should be carried out in conjunction with a facility large enough to handle a volume of samples sufficient to detect several positive cases per year to assure experience in laboratory diagnosis. Efficiency is materially increased when a single central laboratory is utilized. The development of a system of quality control on a statewide or regional basis should be considered to insure a high degree of reliability of results.[202]

Similar consequences to those which resulted from the impact of public pressure on the evolution of PKU legislation (<u>supra</u>, pp. 59-60) might also occur during management of diagnostic facilities and the provision of follow-up services. Past experience with establishing abortion facilities to meet expanding demands[203] and the difficulties which appear to be emerging in the

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[201] "Geneticists Press for Regionalization," <u>Laboratory Management</u>, Vol. 10, October 1972, p. 25.

[202] <u>Recommended Guidelines for PKU Programs for the Newborn</u>, <u>op. cit.</u>, <u>supra</u>, n. 194 at 4. Such a network has been established by the National Genetics Foundation, Inc. Each of their 45 centers in the United States and Canada is staffed and equipped to perform the biochemical and chromosomal analyses necessary to diagnose the most common genetic diseases. In addition, some of the centers have the specialized personnel and facilities required for diagnosis of one or more rare genetic defects. All of the centers are staffed to provide genetic counseling and follow-up to any diagnosis. See their brochure "Genetic Counseling and Treatment Network," (National Genetics Foundation, Inc., 250 West 57th Street, New York 10019).

[203] Neubardt and Schulman discuss the problems which resulted in New York following the changes in its abortion law and conclude that "Abortion has exposed in rather vivid fashion the weaknesses of our medical institutions." <u>op. cit.</u>, <u>supra</u>, n. 68 at 105-106.

development of hospital cardiac programs,[204] demonstrate the problems confronting program planners caught up in a cross-current of public pressure. The problems may already be emerging in the newly-enacted sickle-cell screening programs. Virginia, like a number of other states, hurried to join the bandwagon of states with sickle-cell testing programs. However, Virginia's Department of Health reports that "Sufficient funds have not been appropriated for recruiting or hiring the appropriate number of genetic counselors. . . . Until additional funds are appropriated, we are simply unable to meet all of the responsibilities placed upon us by the new legislation."[205] The consequences which result, and which merit emphasis, are not only that the necessary facilities and services will not be provided, but that a "confidence gap" is created between those designated to provide and perform the services and those who are to receive them. Such a situation obviously benefits no one and, in the final analysis, is probably counterproductive.

J. Screening Costs: There is also a need to consider the cost of screening and counseling services. The use of various diagnostic tests and extensive laboratory work can be quite expensive (for example, a typical examination with ultrasound of a potentially abnormal pregnancy can cost as

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[204] The Inter-Society Commission for Heart Disease Resources reported that hospitals are under new public pressure to enlarge their cardiac programs. The Commission warned that "With the introduction of new techniques for coronary-artery surgery hospitals are again being stimulated to expand their surgical programs and there is evidence we may again see a proliferation of poorly planned units with costly duplications of facilities and suboptimal care." See "Hospitals Warned on Heart Surgery," Washington Post, October 16, 1972, p. A15.

[205] Patricia Hunt, Director, Bureau of Child Health, in a letter to this author, October 6, 1972.

high as fifty dollars). Systematic study is needed of the costs involved in providing genetic services to the population and the extent to which such services are not used because of a family's financial circumstances. Also important is the role of private health insurance in helping families absorb the costs of genetic services. At this time,

> No insurance company . . . recognizes the concept of preventive medicine. The fetus is not recognized as a patient. Cytogenetics is not, for the most part, recognized. The insurance situation seems particularly outrageous when one stops to consider that preventive medicine will be the mainstay of health care in the next century.[206]

As the availability and demand for genetic services increase, the question of costs will become an increasingly important matter.

K. Screening and Genetic Information: The collection and dispersion of genetic information acquired through screening programs also raises important policy questions. As more and more genetic information about individuals and their families is accumulated, how should it be used? What protection should be guaranteed to the individual to whom such information refers? Those who establish data-gathering systems need to be aware of the possible abuse of the information which they possess.

The management of screening programs carries with it two inherent potential sources of abuse. First, in a large-scale screening program

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[206] Carlo Valenti, quoted in Laboratory Management, Vol. 10, October 1972, p. 23. Geneticist Valenti reported that Blue Cross/Blue Shield has "agreed to partially cover the cost of diagnosis depending upon the type of policy held by the patient. However, the reimbursement schedule which they have offered is still less than adequate: $25-40 for a chromosome analysis and $15-25 for a buccal smear. These figures compare with hospital charges of $100 for a diagnosis based upon leukocyte cultures, $250 for a diagnosis based upon amniotic fibroblast cells, and $40 for a buccal smear."

the responsibility for the quality and quantity of care that a patient receives rests with a team of medical experts rather than in the context of of the traditional doctor-patient relationship. Thus, both the medical and ethical responsibilities to the patient are more diffused and consequently more difficult to fix. Experience with PKU screening illustrates this point.

> Not only are records of tests filed in several different places in the state health department, but the entire preventive medicine apparatus of the state, including psychology, nursing, statistics, social services, nutrition, and education, is alerted to the condition. In this process, information which could seriously affect an individual for life is passed about among nonprofessional, nonmedical personnel who have no legal or moral responsibility to the individual.[207]

The second potential source of abuse arises from the use of computerized data-gathering techniques. A vast network of screening programs not only calls for the collection of large amounts of data, but also requires that such data be rapidly and efficiently stored, retrieved and transmitted between diagnostic centers. The ability of the computer to meet these demands makes it an ideal tool for such data management. The problems posed by the use of computers are not new. They simply change the economics and nature of processing information in ways that could result in the abuse of civil liberties. Questions regarding what data is to be collected, for what purposes, to whom it will be made available, and what mechanisms will exist for individuals to obtain and contest such data are all matters for public policy. A recent report of the National Research Council's Computer Science and Engineering Board describes the challenge to policy-makers.

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[207] Bessman and Swazey, op. cit., supra, n. 47 at 73.

> Our task is to see what appropriate safeguards for the individual's rights to privacy, confidentiality, and due process are embedded in every major record system in the nation, particularly the computerizing systems that promise to be the setting for most important organizational uses of information affecting individuals in the coming decade.[208]

The risks involved in the collection of confidential information from any part of the population are accepted by society because of the presumed benefits of using this information. In the case of genetics, for example, the identification of heterozygous carriers would be of great value in estimating the gene frequency among different population. From this information one could calculate the number of individuals who are likely to be affected within the particular population. Thus, better planning for and control of genetic disease are potential benefits to be derived from screening programs. There is a need, therefore, to strike a balance between the community's requirement for information and its subsequent use and the individual's rights of privacy.

L. The Misuse of Information: In developing an appropriate information policy, one should bear in mind the kinds of abuses that might affect a "defective" individual. One such abuse is the possibility of encumbering him with a lifelong public stigma. A diagnostic medical label can destroy or distort relationships within a family and can close access to many of the normal channels and outlets usually open to people. Such influence can result in two ways: first, through affecting an individual's attitudes, his

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[208] Quoted in Gerald S. Schatz, "Computers and Privacy: Continuing Questions of Civil Liberties," News Report, Vol. 22, December 1972, p. 5. (News Report is a monthly publication of the National Academy of Sciences).

image of himself, his self-confidence and, therefore, his involvement in an activity; or second, by identifying a person in such a way so that he is systematically discriminated against. Past experience with genetic diseases illustrates this point clearly. Persons with Huntington's chorea, a disease characterized by progressive mental deterioration, will probably manifest signs of the disease by age 35, but may not have symptoms until a much later age. Until that time they are quite capable of functioning normally. However, the stigma which is often associated with a family with a history of the disease has resulted in "great secrecy within the family because of the fear of social, economic, or legal penalties should the knowledge be made public."[209]

The case of sickle-cell anemia illustrates the problems incurred by the innocent carrier of the disease. The major problem is confusing the person who has the disease with the person carrying the trait, but not the disease symptoms. A recent report expressed concern about the

> dangers of societal misinterpretation of similar conditions and the possibility of widespread and undesirable labeling of individuals on a genetic basis. For instance, the lay public may incorrectly conclude that persons with sickle trait are seriously handicapped in their ability to function effectively in society . . . Extreme caution should therefore be exercised before steps that lend themselves to stigmatization are taken.[210]

A consequence of such stigmatization is that "much unnecessary anxiety on the part of parents and trait carriers and psychologic harm occurs when some

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[209] John Whittier, Audrey Heimler and Charles Korenyi, "The Psychiatrist and Huntington's Disease (Chorea)," American Journal of Psychiatry, Vol. 128, June 1972, p. 1550.

[210] Institute of Society, Ethics and the Life Sciences, op. cit., supra, n. 154 at 1132.

persons are identified as carriers of sickle-cell trait without an understanding of the harmlessness of their trait."[211] Individuals might come to be regarded as physically weaker or less fit. An example drawn from experience with another disease may help to illustrate the possible harm. Dr. Nicholas Hobbs, director of the staff for a five-agency federal study of labeling, has reported "growing evidence that for a child to be labeled anything - whether the label is 'mentally retarded' or 'gifted' - influences what social system he gets into and shapes his whole future."[212] Hobbs cites the example of a young child who was found to have a heart murmur. He was treated differently by his parents, "sheltered and not allowed to play with other children." Five years later doctors found the child's heart perfectly good, but by then "he had already developed a picture of himself as having heart disease and had taken on a restricted life-style that may never fully reverse." Great care must be taken, therefore, to avoid "overprotecting" carriers when it might later result in their adopting unnecessary and restrictive life-styles.

Another problem has been the denial to some sickle-trait carriers of employment opportunities or life and health insurance. For example there are reports that an airline stewardess was grounded after the airline discovered she carried the trait.[213] Also, insurance companies "have been

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[211] Beutler, et. al., op. cit., supra, n. 177 at 1486.

[212] Quoted in Suzanne Dean, "Study Probes Labeling of Children as Retarded," Washington Post, September 6, 1972, p. A8.

[213] Rudolph Jackson, Coordinator, National Institutes of Health sickle-cell disease program, quoted in B.J. Culliton, "Sickle Cell Anemia: The Route from Obscurity to Prominence," Science, Vol. 178, October 13, 1972, p. 141.

changing or raising the premiums or dropping insurance on persons with the trait . . ."[214] Thus, "sickle-cell testing has shown up in employment records, in insurance company records, and is becoming more and more abused by people who do not understand the nature of the disease."[215] While certain carriers of the sickle trait can experience some problems where the oxygen supply is diminished, most carriers will never have any problems and there is "no evidence that trait carriers have a higher risk of disease or a shorter than normal life-span."[216] This stigmatization of sickle-cell carriers has "created emotional resistance among many persons to sickle cell screening and genetic counseling . . ."[217] and consequently, the effectiveness of such programs has been greatly impaired.

The XYY chromosome abnormality presents yet another problem associated with stigmatization. This sex anomaly occurs in males with two Y chromosomes and one X chromosome (the normal chromosome complement for males is one of both X and Y chromosomes). The controversy which surrounds this aberration concerns the extent to which its presence predisposes an individual to engage in antisocial and violent behavior. A review of the literature indicates that the controversy is far from resolved. On the one hand, there are studies

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[214] Rudolph Jackson, quoted in "Bias Against Sickle Trait Victims Probed," Washington Post, November 14, 1972, p. A6. Some insurance firms have been reported to charge trait carriers as much as "150 per cent of the usual premium . . ." Joseph Christian, quoted in Culliton, op. cit., supra, n. 213 at 142.

[215] Mona Blake, School Board, Fairfax County, Virginia, quoted in "Sickle Cell Examination is Opposed," Washington Post, November 1, 1972, p. B9.

[216] Christian, op. cit., supra, n. 213.

[217] Cohn, op. cit., supra, n. 153 at A1.

which suggest a correlation between the XYY abnormality and certain types of aberrant behavior, with one concluding that "the additional Y-chromosome genetically predisposes the 47, XYY male to the development of a psychopathic personality and to consequent aberrant behaviors and antisocial conduct."[218] There is equally persuasive evidence, however, which suggests that there is no strong correlation between the presence of the XYY chromosome complement and a particular type of behavior. Two researchers recently claimed that the suggestion that "XYY males are uncontrollably aggressive psychopaths appears to be nothing more than a myth promoted by the mass media."[219] In addition to the mixed findings suggested by these studies, there are also questions regarding the methodological and conceptual approaches employed in the investigations.[220] In light of this continuing debate, therefore, any attempt to develop policy which seeks to respond to the needs of individuals with the XYY anomaly would be premature.[221] The present state of knowledge does not

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[218] W.M. Court Brown, "Males with an XYY Sex Chromosome Complement," Journal of Medical Genetics, Vol. 5, 1968, pp. 348-49. Also see Lytt Gardner and Richard Neu, "Evidence Linking an Extra Y Chromosome to Sociopathic Behavior," Archives of General Psychiatry, 26: 220-222, March 1972.

[219] Seymour Kessler and Rudolf H. Moos, "XYY Chromosome: Premature Conclusions," Science, Vol. 165, August 1, 1969, p. 442. Also see S. Wiener and G. Sutherland, "A Normal XYY Man," Lancet, 2:1352, December 21, 1968.

[220] Saleem A. Shah (ed.), Report on the XYY Chromosome Abnormality, (National Institute of Mental Health: U.S. Government Printing Office, 1970), Public Health Service Publication No. 2103, pp. 23-27.

[221] The questions for policy consideration might include how much effort should be directed toward rehabilitating criminals if the underlying basis for their abnormal behavior is genetically determined. Or, how should the XYY individual be dealt with both prior to and following the commission of a crime? Since the XYY chromosomal abnormality can be detected *in utero* by amniocentesis, does society have a right to intervene into the reproductive decision of couples found to have conceived an XYY child?

permit any definitive statement regarding the possible link between the XYY complement and certain types of behavioral pathology. This lack of consensus highlights the danger "that incomplete or inadequate understanding of the phenomena might possibly become embedded into public policy or legislative enactments."[222] Thus, there is a need for more systematic data collection and research into this problem, and others like it, in order to provide the necessary information from which policy decisions can be made. While such research itself creates problems regarding the confidentiality of data and individual privacy, the problem of stigmatization is apparently an immediate one. A recent investigation concluded that XYY men had been falsely stigmatized[223] and it is not unreasonable to assume that such information, when improperly understood, might affect a man's opportunities for gaining employment or obtaining parole, or prejudice his judicial proceedings.[224] Furthermore,

> presumptions that a person's chromosome pattern clearly disposes him toward aggressive and antisocial behavior could lead to further stigmatization of that individual. Responses from others interacting with him might be of

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[222] Saleem A. Shah, "Recent Developments in Human Genetics and Their Implications for Problems of Social Deviance," in Daniel Bergsma (ed.), Advances in Human Genetics and Their Impact on Society, (Birth Defects: Original Article Series, Vol. 8: The National Foundation - March of Dimes, July 1972), p. 79.

[223] G.R. Clark, M.A. Telfer, D. Bajer and M. Rosen, "Sex Chromosomes, Crime and Psychosis," American Journal of Psychiatry, 126: 1659-63, 1970.

[224] Recently, a public-interest group threatened a law suit regarding a study inquiring into the frequency of XYY males in a population of children. The group felt it an invasion of privacy to get information about an individual that might guide his future treatment. They took the view that the law might use this information in some way that would adversely affect the individual. For example, if it was known that an individual was an XYY, there might be a greater tendency to judge him guilty if arrested by police. See Robert Cooke, quoted in Maureen Harris (ed.), op. cit., supra, n. 105 at 82.

> a form that would tend to promote aggressive behavior, thereby making a possible unwarranted assumption become a self-fulfilling prophecy.[225]

Care must be taken, therefore, to guard against such abuses.

M. Safeguarding Research Data: As suggested earlier, research into the XYY problem will create its own difficulties. It is important, then, that the requirements of rigorous scientific research be balanced with the proper respect for and protection of the rights and welfare of the subjects under study. The proper protection of the rights of research subjects requires policy that will safeguard confidential records and protect access to such information. Unfortunately, only eleven states have statutes that recognize the confidentiality of general research information of a public health nature.[226] Investigators thus face serious difficulties in protecting such information from court subpoenas. Even when such statutes are in operation, however, they are often "overly broad in regard to the possible range of material considered confidential within the statutes, and thus the researchers and even more importantly the subject may be misled in relying on a statute that might be given a narrow judicial construction."[227] It would seem to be an appropriate role of the legislature to formulate more discriminatory models for safeguarding the confidential nature of research data. The XYY anomaly, as well as experience with other genetic abnormalities, illustrates the potential problems of data management in large-scale screening programs.

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[225] Shah (ed.), op. cit., supra, n. 220 at 9.

[226] Ralph K. Schwitzgebel, "Confidentiality of Research Information in Public Health Studies," Harvard Legal Commentary, Vol. 6, 1969, p. 192.

[227] Ibid., p. 196.

N. Public Education: Much of the stigmatization cited above can be lessened, and perhaps to a great extent avoided, if the public can be educated about the nature and consequences of genetic disease. In the case of sickle-cell disease, the issue is not merely identifying trait carriers, but giving those individuals and society better information about what being a trait carrier means. An educated public can thus be a means of "reducing the potential risk that those identified as genetically variant will be stigmatized or ostracized socially."[228] So far, efforts in this direction have not been very successful. The excessive pessimism and hostility among blacks toward genetic screening programs has been attributed to the "large amounts of 'unfortunate sensationalism' and badly informed 'scare campaigns' in TV and newspapers."[229] Clearly, a more carefully constructed and broad-based educational campaign should accompany genetic screening.

Education, however, has other important functions to perform. Studies indicate that most people are unaware of the opportunities for genetic services, with persons of the lower socio-economic classes relying "primarily on family and friends for information, [which] means not only that they are not likely to be as informed as others, but that there is an increased chance that they will in fact receive incomplete and often erroneous health information."[230] Thus, an important task will be to make people aware of available medical opportunities. Education is also necessary if persons are to be able to make

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[228] Institute of Society, Ethics, and the Life Sciences, op. cit., supra, n. 154 at 1130.

[229] Cohn, op. cit., supra, n. 153.

[230] Sorenson, op. cit., supra, n. 196 at 7-8.

intelligent decisions regarding their future medical and genetic status. A survey of PKU parents demonstrates the educational challenge ahead. The survey was designed to find out how much such parents knew about their circumstances; the results were not very encouraging.

1. 61% did not know the disorder was inherited;
2. 58% did not understand the importance of early diagnosis;
3. 56% said that they had never discussed the condition with a professional source;
4. 56% did not know that the condition can be treated with a special diet.[231]

If genetic screening programs are to be effective in ameliorating the effects of genetic disease, an educated public is essential.

IV. Genetic Counseling

Genetic counseling is one of the most important means for transforming the results of medical and genetic's research into measures designed to provide immediate and practical aid to individuals. The emphasis of the following discussion will be on the training requirements for genetic counseling, the possible roles that genetic counselors might assume in performing their counseling services, doctor-patient communication, and the responsibilities of the genetic counselor to his patients and society, particularly with respect to the information to which he has access.

A. Training Requirements: Today there are about 200 genetic counseling units in the United States. With the increasing awareness of the need for counseling, the number of these units should proliferate. The services offered by the units, however, will only be as good as the counseling personnel which

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[231] Lloyd Kramer and Benjamin White, "A Survey of Families and Relatives of Proven Phenylketonuria (PKU) Patients in Maryland," Paper presented at 92nd Annual Meeting, American Public Health Association, 1964.

provide them.

> What appears to be developing . . . is a rapidly expanding knowledge base permitting increasingly refined prediction and control of genetic and chromosomal problems, but no concomitant professional or organizational locus of training, socialization and control. What this means is that genetic counseling as currently practiced exhibits considerable diversity. With no singular professional training experience, counselors rely largely on their individual medical backgrounds, local institutional constraints, as well as the specific demands placed on them in the counseling session to shape their counsel.[232]

As a result of this diverse and often narrow educational and training experience, two problems emerge. First,

> because most physicians lack adequate training in diagnosing genetic defects, misdiagnosis and inappropriate advice can be serious problems. For example, if a couple are told that a given problem is genetic and accordingly opt for sterilization, they have taken an irreversible step. If the doctor was wrong, not only has he caused the couple much grief, but he is legally liable. The current structure of genetic counseling facilities combined with the lack of diagnostic capacity make such problems likely. In addition, given the current lack of training in medical genetics, practicing physicians probably ignore the genetic aspects of many diseases.[233]

The second problem which stems from this diversity in backgrounds is that

> Professional counselors . . . tend to erect fences around their area of counseling interest and, by fiat, allow other professionals to give genetic facts but not counseling.
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> Counseling preserves established by vested areas of interest also increase the likelihood that families will miss vital pieces of information. When no one person carries

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[232] James R. Sorenson, "Factors Shaping Decision Making in Applied Human Genetics: Professional and Client Perspectives," Department of Sociology, Princeton University, August 1972, p. 4.

[233] Sorenson, op. cit., supra, n. 169 at 27.

> the primary responsibility for organizing the genetic information and counseling the family, important aspects of information may be overlooked.[234]

There is a need, therefore, to define qualifications and to provide proper training for genetic counselors and to consider appropriate guidelines for the conduct of counseling services. Ladimer suggests that appropriate standards should cover the

> (1) definition of the field or process of genetic counseling; (2) scope of services; (3) practitioners qualified to serve; (4) institutional and other settings suitable for counseling; (5) protection of interests; (6) relation to other fields, professions and services; (7) methods for evaluation; and (8) professional and community obligations.[235]

Certainly, an important goal of training counselors should be to sensitize them to the wide variety of needs and expectations that may be expressed by their patients.

B. Role Orientation: Sensitizing the genetic counselor to patient needs and expectations naturally raises the question of how he should relate to his patients. The role orientation of counselors has been a subject of considerable discussion. Two basic positions can be distinguished. On the one hand, there are those who view the counselor as an informer, whose task is simply to inform the couples of the risks involved. They see any attempt on the counselor's part to influence the decisions of those whom he counsels as beyond his professional responsibility as a counselor. On the other hand, there are those who view the counselor as a wise advisor, one whose concern for the patient exceeds a mere presentation of the facts and calls for a closer

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[234] Reisman and Matheny, op. cit., supra, n. 15 at 27.

[235] Op. cit., supra, n. 186 at 13.

involvement with his counselees. No matter which of the two views one adopts, it is important to recognize the influential role which a counselor can assume. Sorenson has observed that

> counselees are often informationally dependent on the counselor for not only a technical diagnosis and assessment of their situation, but they seek in addition some assistance in giving meaning to the condition they find themselves in, a condition of calculated risk, but a condition for which there are few behavioral precedents as to how to interpret these risks or how to make sense out of them.[236]

Thus, lacking adequate and meaningful information, a couple seeking help is confused and worried. They are searching for someone with authority to answer their questions and this "dependency role" may make them more susceptible to the counselor's own views. And it is difficult, if not impossible, for the feelings of the counselor not to be conveyed to his patients.[237] The opportunities which exist for counselors to influence the decision of a couple are illustrated by the following example.

> If the couple is facing the risk for an autosomal recessive disorder the counselor can tell the couple that they have a three in four chance of having a normal child. He might do this if he thinks that the couple ought to have more children. On the other hand, if he is pessimistic and believes that the couple ought not to chance reproducing he might say that they face a risk of one in four that the child will be abnormal. In both cases the same factual

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[236] *Op. cit.*, *supra*, n. 232 at 15. Sorenson presents an excellent description and analysis of the context in which genetic counseling occurs, emphasizing the evolution of a new doctor-patient relationship and its implications for applied genetic decision-making.

[237] Fletcher's study tends to support this point, with the finding that "The counselor's wishes for outcomes in a case will be conveyed directly or indirectly to the patient." (emphasis added) *Op. cit.*, *supra*, n. 134 at 60. The importance of recognizing and analyzing the nature of this influence is stressed by Sorenson, who writes that "the ultimate role of who makes final decisions regarding the use of genetic knowledge is usually less ethically and morally neutral than is the situation in the delivery of more standard medical services." *Op. cit.*, *supra*, n. 196 at 19.

> information is conveyed to the clients. In the first situation the counselor stresses normality, while in the second he stresses the potential abnormality. This variation is certain to have an impact on the decision of the clients.[238]

Thus, the genetic counselor's own biases may well become important factors influencing a family's decision.

C. Doctor-Patient Communication: The ultimate quality of genetic counseling will, to a large extent, depend on the interaction between the patient and the counselor. Of the various factors which contribute to this interaction, certainly one of the most crucial is the communicative process between the counselor and his counselees. How well do patients receive, comprehend, and apply the information given to them by their physicians? To what extent are instances of misunderstanding and distortion due to the patient's or physician's inability to "communicate"? Answers to these questions are crucial, for it may well be that shortcomings in the treatment of a chronic illness can be related to such misunderstanding or distortion.[239]

There appear to be at least three pertinent clearly-defined variables in the doctor-patient communicative process. First, there is the ability of the physician-counselor to communicate information to his counselees. Of what value is it to have pertinent information unless the counselor is able

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[238] Sorenson, op. cit., supra, n. 196 at 22.

[239] Undoubtedly, many individuals distort, forget, or reject the genetic information conveyed to them by the genetic counselor. A study of parental understanding of phenylketonuria concludes: "If exposing parents to medical information aims at improving their understanding of the illness or at favorably influencing the course of the child's illness, the present study provides no support for either contention." Maarten S. Sibinga and C. Jack Friedman, "Complexities of Parental Understanding of Phenylketonuria," Pediatrics, Vol. 46, August 1971, p. 222. The study's sample population included 42 families of children with PKU.

to deliver it effectively? But while it is the counselor's role to promote effective communication, it is a role, according to some, "for which most physicians have unfortunately had little training."[240] The problem resulting from poor communication is described by a recent study of doctor-patient communication in a pediatric clinic of a large hospital. The study found that physicians tend to be overly technical in the language they use with their patients. "In more than half of the cases we recorded the physicians resorted to medical jargon. This did not necessarily leave the patient dissatisfied; . . . It did, however, leave most of the mothers unenlightened about the nature of the child's illness."[241] This problem is also applicable to genetics. Unless the information is properly explained and understood, it may evoke unreasonable fear on the part of families. For example, in a follow-up study at a genetic counseling clinic, it was found that in some instances odds had no meaning to couples. "The mother of a child with a myelocele remembered that she had been given a 1 in 25 risk, but said that if she had another child 'either it would or would not be affected and so the risk is 50/50'."[242] On the basis of her reasoning, this woman had adopted three children. Unquestionably, then, "attention to effective communication, a skill that should not be too difficult for any trained person to master, could make a valuable contribution to the quality of health care and its availability to the general population."[243] Genetic counseling would appear

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[240] Reisman and Matheny, _op_. _cit_., _supra_, n. 15 at 30.

[241] Barbara Korsch and Vida Megrete, "Doctor-Patient Communication," _Scientific American_, Vol. 227, August 1972, pp. 71-72.

[242] Carter, _et_. _al_., _op_. _cit_., _supra_, n. 163 at 282.

[243] Korsch and Megrete, _op_. _cit_., _supra_, n. 241 at 74.

to have much to gain from a concerted effort in this direction.

In a recent study in a congenital heart clinic with a well trained genetic counseling unit, it was found that after receiving genetic information only about 25 per cent of the families retained and understood the attendant recurrence risks.[244] Thus, even with highly-skilled genetic counselors, the reception and understanding of genetic information was significantly impaired. This leads to a second variable in the doctor-patient communicative process: the basic knowledge of biology and genetics that patients bring to the counseling session. Leonard and his colleagues found that "the substratum of biologic knowledge possessed by many parents is inadequate to support the information imposed upon it by the counselor."[245] In the long run, therefore, there is a need for a better-educated public. Of more immediate concern, however, is the need for systematic and empirical investigation into how counseling information is received and applied. Perhaps such information should be repeated. If so, how often and at what intervals? It might also be helpful to modify counseling services to the specific educational and socio-economic backgrounds of the consumers. How this might be most effectively and efficiently accomplished will require additional study.

While greater education is a necessary prerequisite for more effective doctor-patient communication, it is apparently not always suffient for producing the desired effect, e.g. the family's understanding of the counseling information. In a study of PKU families, "Parents with greater education were

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[244] J.A. Reiss and V.D. Menashe, "Genetic Counseling and Congenital Heart Disease," Journal of Pediatrics, 80:655-656, April 1972.

[245] Leonard, et. al., op. cit., supra, n. 165 at 438.

no less inaccurate or distortion prone than those with less education . . ."[246] The investigators suggest that "the capability to understand illness might be considered an emotional phenomenon."[247] Thus, a third important variable is the context in which genetic counseling is provided. A recent study of genetic counseling cited "emotional conflict" as an inhibiting influence on a family's understanding of counseling information.[248] To what extent, then, do parents remember information given to them when the context is so emotionally charged? Is reinforcement required? If so, what forms should it take? Clearly, the emotional context of genetic counseling requires careful assessment when considering ways to improve the counseling process.

Doctor-patient communication, then, is an essential element of the counseling process and thus becomes an important criteria for designing and evaluating genetic screening programs. The three variables discussed above must be viewed as essential elements of doctor-patient communication, which, if carefully studied, evaluated and improved upon, could contribute to more effective control of genetic disease.

D. "Responsible" Genetic Counseling: How one defines the responsibility of the genetic counselor to his patients will depend, to a large extent, on the way one characterizes the practice of genetic medicine. There are those who contend that genetic screening and counseling are altering the paradigm of the

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[246] Sibinga and Friedman, op. cit., supra, n. 239.

[247] Ibid.

[248] Leonard, et. al., op. cit., supra, n. 165. The investigators noted (p. 435) that five of the families interviewed "observed that the genetic information given at the time of diagnosis or shortly thereafter was not retained because of emotional shock." Also, see supra, pp. 63-64.

traditional doctor-patient relationship and thus changing the nature of the physician's responsibilities within that context. Traditionally, the practice of medicine was primarily devoted to individual therapy, with the patient the responsibility of a single physician. Large-scale screening programs, however, have shifted the focus of attention from the individual to a larger population and from a single physician to team care. While medical codes regarding the professional responsibilities of the physician to his patient have been adequate for those problems arising from the traditional practice of medicine, new genetic technology and the kinds of medicine it makes possible may require a reevaluation of the ethical norms governing medicine. Perhaps the best illustration of the problems which can arise concerns the kinds of information that should be given to the patient.

Under the traditional doctor-patient relationship, the physician examines his patient and, on the basis of his diagnosis, then acts to prescribe the most effective alternative for alleviating the illness. In this arrangement, the patient assumes that the physician possesses superior knowledge concerning questions of medicine and health. This is not the case in genetic counseling. "There is no assurance that a counselor has any more expertise than the counselee in evaluating risks for recurrence of a problem or in estimating the ability of the family to adequately handle a problem, should it occur."[249] Under these circumstances, then, the counselor gives a couple information so that they can act, rather than as a prerequisite to his acting on them. Questions arise, however, concerning the status of a

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[249] Sorenson, op. cit., supra, n. 232 at 9.

physician's therapeutic privilege in the counseling context. What information should he give to his patients? Unfortunately, traditional ethical precepts offer little guidance. Consequently,

> Since there are few normative guidelines outlining the information that should be given in the counseling sessions, other than the provision of minimal information about the disease and its recurrence risk, the actual information that is exchanged, and the degree to which this constitutes counsel, advice, or behavioral suggestion, varies depending on the particular conditions.[250]

The problems which may emerge from this unsettled situation can be demonstrated by the following "cases."

Earlier discussion of the XYY chromosome abnormality emphasized the inconclusive nature of research concerning its consequences on human behavior (supra, pp. 73-74). Assume for the moment that amniocentesis is performed on an expectant mother concerned that her child might be a Tay-Sachs baby. While no evidence of Tay-Sachs disease is found, the abnormal XYY chromosome abnormality is discovered. What should the counselor tell the mother? One question which this example raises is whether a counselor can simply act as an "informer," responsible only for providing his patients with the facts? In the case of the XYY anomaly, what are the "facts"? What considerations should the counselor give to the effect on the parents and their family situation if given this information? Might parental concern about the possible presence of an abnormality adversely influence their care of the child? A recent report on the XYY anomaly suggested that "parental expectations and apprehensions about possible - but as yet unknown or even non-existant -

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[250] Ibid., pp. 16-17.

problems, may well create certain difficulties and lead unwittingly to self-fulfilling prophecies."[251] Perhaps more importantly, should individual counselors, each with their own built-in biases and operating within the context of varied family situations, be given the responsibility to make such decisions? By whom and by what criteria should such responsibility be allocated? And if a child or young adult, while participating in a screening program to detect other sex anomalies is found to be an "XYY" should he be informed of this condition? Ramsey raises the question of "whether the individual might be endangered by the acquisition, in any society, of complete knowledge [or in the XYY case, of partial and as yet unconfirmed knowledge] of his behavioral genetics? Such knowledge may be too heavy for many to bear and still remain spontaneous and free in their personal lives."[252] Without any common ethical perspective, answers to these questions would undoubtedly vary from counselor to counselor and according to the situational context in which they occur.

In cases in which early detection of a disease cannot be accompanied by appropriate treatment for the patient or his family, the question arises whether the uncovering of the disease does more harm than good. The urgency of this question is demonstrated by the possible development of a safe and accurate test for presymptomatic detection of Huntington's chorea.[253] A

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[251] Shah (ed.), op. cit., supra, n. 220 at 26.

[252] Op. cit., supra, n. 86 at 174.

[253] H.C. Klawans, G.W. Paulson and A. Barbeau, "Predictive Test for Huntington's Chorea," Lancet, 2: 1185-86, December 5, 1970. The authors report using "levodopa" as their testing agent. They stress the need, however, for additional experimental testing and caution against hasty interpretations

reliable and accurate test will mean that persons who lack the deleterious gene will be reassured that the disease will not develop, and, thus, they will also be reassured that any children that they might have will be unaffected. But for those whose tests are positive, they will be confronted with the fact that their future will include gradual physical and mental degeneration. This possibility has led some to argue that "it is not unreasonable to withhold the use of a test of this sort until we have something tangible to offer to those who give a positive result," suggesting that "depression and the risk of suicide would be more or less inevitable."[254] There are those who would object to this alternative, finding "no reason to deprive the patients involved of the right of decision to learn, early or late, their inevitable fate."[255] (emphasis added) It is important to remember that if the test is to be of value, persons with predictive signs of Huntington's chorea must refrain from having their own children. If such persons are to be informed, then it is imperative that the counselor carefully evaluate the emotional state of the patient prior to telling him. "Should the diagnosis be confirmed without proper preparation, serious behavioral or mood disorders may ensue, including suicide."[256] Thus, what is to be told and how it is to

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of test results, noting that "A positive result does not prove Huntington's chorea, it only increases the prediction coefficient . . . . A negative result is still meaningless and requires new evaluation in years to come."

[254] David L. Stevens, "Test for Huntington's Chorea (cont.)," The New England Journal of Medicine, Vol. 285, August 12, 1971, p. 414.

[255] Willard Gaylin, "Genetic Screening: The Ethics of Knowing," The New England Journal of Medicine, Vol. 286, June 22, 1972, p. 1362.

[256] Whittier, et. al., op. cit., supra, n. 209 at 1550.

be told assume new proportions in the information equation established between the counselor and his patient.

While the above examples are single, isolated cases, they help to demonstrate some of the issues which may emerge concerning the counselor's responsibility in providing information to his counselees. A general overview of this responsibility highlights four additional policy questions. First, is the question of whether persons are deprived of their freedom of choice when pertinent information is withheld. Without the knowledge necessary for making intelligent decisions, is the power to decide still meaningful? When arbitrating the question of what to communicate to the patient, it should be remembered that "For parents, genetic counseling can constitute a fundamental crisis, or emergency, in their reproductive careers. At issue is the decision as to whether to keep open or to close the social family biologically."[257] To what extent, then, should a "third party" be permitted to take that decision (in any meaningful sense of the term) away from a couple?

A second issue concerns the validity of the assumption that the withholding of information would be in the best interests of the patient. Some geneticists express the opinion that, in the case where there is no effective therapy for an illness, informing the patient and his family of his condition will do more harm than good. Knowledge of the condition

> prior to its clinical manifestation may merely provoke increased patient or parental anxiety without offering them any positive reassurance. There will be little benefit to the patient and, for a time, at least, some possible degree of harm to the parents and patient, depending upon their emotional stability.[258]

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[257] Sorenson, op. cit., supra, n. 232 at 10.

[258] Murray, op. cit., supra, n. 189 at 10

It is certainly questionable, however, whether the counselor will be able to determine what the "best interests" of his counselee are. Genetic counselors, unlike the family physician, are not well-acquainted with their patients and their families. Thus, some believe that "When counseling becomes much more routine, part of the accepted practice should not be the routine of withholding information from the counselees on the spurious grounds that the counselors know what is best for patients they hardly know at all."[259] There is also the problem of a physician's own values, which may differ from those of his patients, and the effect that they might have on his judgment to discern his patient's best interests. "The potential for conflict is especially great in genetic counseling in which the options elected depend on one's opinions about such controversial matters as the importance of the traditional concept of family, the morality of divorce and of abortion, . . ."[260]

The cornerstone of the doctor-patient relationship is the patient's trust in the integrity and ability of his physician. This poses a third question: If information that is withheld today is discovered later, what will be the effect on the relationship between the medical profession, and particularly genetic counseling, and its patients? Might there be a general loss of confidence in the medical profession brought about by the routine withholding of information? When could a patient be sure that he was being told all? The possible damage to the practice of medicine and its consequent impact on

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[259] Alexander M. Capron, "Ethical and Legal Aspects of Genetic Counseling," Paper presented at the First Advanced Symposium: Genetic Counseling, The New England Institute, Ridgefield, Connecticut, July 6, 1972, p. 4.

[260] Ibid., p. 5.

the health of the population must be added to the growing list of policy considerations.

The fourth and final broad policy question concerns the nature of the counselor's responsibility beyond his individual patient. Specifically, what is the responsibility of the counselor toward a patient's family and society? With respect to access to information, it has been suggested that "As a general rule all unambiguous diagnostic results should be made available to the person, his legal representative, or a physician authorized by him."[261] A question arises as to whether a patient's family should also be told, since this might give them the opportunity to evaluate intelligently their own health status. It has been suggested that the traditional, confidential doctor-patient relationship might be less important than people's "right to know about the risks that they run, whether infectious, toxic, or genetic."[262] And if such information is withheld, could the physician or screening program administrators be found legally negligent?

There may be instances in genetic medicine where the needs of the individual and those of society conflict. Considering the possible dangers of the presence of the XYY chromosome abnormality, does the counselor have the responsibility to forewarn the community and perhaps expose the XYY individual and his family to an undercurrent of social and legal pressures? And upon making a diagnosis of Down's syndrome and advising his counselees, to what extent should the counselor consider the costs to society of providing

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[261] Institute of Society, Ethics and the Life Sciences, op. cit., supra, n. 154 at 1131.

[262] John Littlefield, quote in Time, June 26, 1972, p. 51.

institutional care for that child? This issue requires considerable thought and leads one to ask if the individual physician is in a position to measure and evaluate the cumulative, and sometimes remote, effects of his individual acts? Should such considerations influence the case of his patient? It might well be that "The individual physician is unfaithful to the trust the patient places in him if he withholds a specific therapeutic agent in anticipation of some eventual perturbation of human ecology. Society, therefore, cannot possibly delegate such decisions to each physician."[263] But how society and its institutions is to make these decisions is far from clear.

Genetic technology is becoming an increasingly important part of society's vast medical arsenal. Applying such knowledge, however, may create a myriad of problems. In the hope of stimulating discussion and focusing attention on the most pressing policy issues related to genetic technology, this paper has sought to identify and analyze some of the major problem areas. It is apparent that society must begin to make some conscious decisions regarding the use of this technology. How these decisions are made will affect not only the health of this generation, but that of many generations to come. These, then, are the promises and problems of genetic technology.

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[263] Edmund D. Pellegrino, "Physician, Patients, and Society: Some New Tensions in Medical Ethics," in E. Mendelsohn, _et_. _al_., _op_. _cit_., _supra_, n. 47 at 80.

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V. CASE STUDIES

E. Community Level Impacts of Expanded Underground Coal Mining

Vary T. COATES, P.I.

May 1975, pp. 1-35

INTRODUCTION

Under a research contract from the Electric Power Research Institute, Hittman Associates, Inc., undertook to perform "A Technology Assessment of Extraction of Coal by Underground Mining Methods." Project Independence anticipates increasing coal production from 599 million tons per year to between 1.2 and 1.5 billion tons within ten years, much of the increase to go for the generation of electricity. It is further anticipated that accomplishing this objective will require the opening of one new underground mine (as well as one new surface mine) per month during the ten year period. Hittman Associates was therefore asked to evaluate the requirements for deep mined coal in terms of alternative future production strategies, to analyze the interrelationships among technological components of the deep mining process, to describe operational constraints on the expansion of deep mining, to analyze the impact of present and projected developments upon the physical, social, and community development environments, to identify present, potential, direct, and indirect participants and affected parties and their role in this development, and to specify and assess a range of public and private policy alternatives which are practically available to increase the production of deep mine coal for electric generation.

As a subcontractor to Hittman Associates, The Program of Policy Studies in Science and Technology (The George Washington University) was asked to (1) identify and evaluate the various roles and interests of the groups directly or indirectly connected with (potentially affected by) underground coal mining; and through consultation to assist Hittman Associates in their performance of two further tasks: (2) analysis of impacts of expanded coal production in a

geographical area or community selected by them for a "site study" or "case study," and (3) specification of a range of public and private policy alternatives (including strategies for related R&D and monitoring requirements) which appear to be practically available to increase the production of deep mine coal and delineation of the consequences of adopting each alternative.

In carrying out these tasks, the Technology Assessment Group (TAG) of the Program of Policy Studies in Science and Technology:

(a) reviewed recent and current literature concerning underground coal mining, in order to develop a tentative list of potentially affected parties and participants in the process (see Appendix A, Bibliography);

(b) conducted lengthy but informal interviews with representatives of such participants and parties who could be identified in Washington, D.C. area (see Appendix B for a list of interviews);

(c) analyzed available census materials and other data related to the counties selected by Hittman Associates for their case study or site investigation (Marion and Monongalia Counties in West Virginia);

(d) conducted interviews with community representatives, leaders, and decision makers in the selected West Virginia Counties, in order to identify other potentially affected parties who may not be represented by recognized or organized interest groups (see Appendix C);

(e) sought for case studies of similar communities where rapid expansion of similar extraction industries (or the decline of such industries) has occurred, and utilized one such case history for comparison with the West Virginia counties, in order to project and generalize potential impacts on the country as a whole.

The following report deals only with community level impacts and describes the situation in one western county where rapid expansion of an extraction industry, closely similar to underground coal mining, has recently occurred. It then attempts to project the impact which similar development might have on

Marion and Monongalia Counties, West Virginia, in order to forecast the impacts at the local level which may be anticipated from a national expansion of deep coal production such as envisioned by Project Independence. In this report, we have relied heavily on recent studies by the Technology Assessment Group (TAG) of six communities in other sections of the country to provide a baseline of information about problems and trends affecting rural small communities.

COMMUNITY LEVEL IMPACTS OF EXPANDED UNDERGROUND COAL MINING

I. The Case of Sweetwater, Wyoming.

In order to forecast the potential local impacts of underground coal mining expansion, and to generalize these to national and regional impacts, it is instructive to look at a case history of a county in which rapid expansion has already occurred in a very similar industry.*

Sweetwater County, Wyoming, historically depended on railroading and coal mining as the mainstays of its economy. Both declined rapidly after World War II, railroad employment dropping from 1,700 in 1950 to under 300 in 1974, and coal mining employment from 2,000 in 1960 to almost nothing in 1974 (some increase in coal mining is now expected).

Other industries took up the slack, chiefly construction of Flaming Gorge Dam, oil and gas production, and a steady growth in trona mining. By 1970 mining and processing -- including trona, oil, and coal -- employed 1500 people.

In 1970 a boom began in Sweetwater County, as a "cumulative result of separate (corporate) decisions to invest large amounts of capital" in trona plant and mining operations and in construction at the Jim Bridger Power Plant.

Trona, used as an industrial chemical, is natural soda ash, and is mined with processes and technology very similar to those used in underground coal mining. Miners from West Virginia have in fact been recruited to work in

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*John S. Gilmore and Mary K. Duff, University of Denver Research Institute, Denver, Colorado 80210: A Growth Management Case Study: Sweetwater County, Wyoming. Final draft, December 1974. Prepared for Rocky Mountain Energy Company.

We are greatly indebted to John Gilmore for permission to draw heavily on DRI's excellent study. We have endeavored to report the findings of this study as accurately and faithfully as possible, and apologize in advance for any inadvertent misinterpretation.

western trona mines since they need little or no further training. Thus we can relate the experiences of Sweetwater County to the potential local impacts of rapid expansion of underground coal mining.

From 1971 to 1974, mining employment increased 73 percent, from 1,530 to 2,650 men, better than 17 percent growth per year. Construction employment [associated both with trona mining and the power plant] shot up from 400 to 4,800. Local and state government employees, including school teachers, correspondingly rose from 880 to 1,300.

Total employment in the county from 1970-74 more than doubled, from 7,230 to 15,225. County population also doubled, from 18,391 to 36,900. According to Gilmore* a growth rate of five percent per year would have been manageable, but Sweetwater's growth from 1970 to 1974 was 19 percent per year. The infrastructure was inadequate. The market mechanism was unable to furnish the factors of production. Housing was in short supply and prices rose rapidly, retail sales facilities were overloaded, and the financial viability of municipalities and school systems deteriorated through a lack of both capital and operating funds.

The housing industry was unable to respond rapidly to the sudden demand. Construction labor had to be imported and pirating was common. Local sewage treatment was inadequate and housing developers had to build treatment facilities. Much of the land in the county was owned by the government (as is the case in many western counties) and a few large owners -- some of them corporations -- held the rest, so that a seller's market prevailed. The result was that new housing was priced too high for workers; the largest homebuilder in

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*Op. cit.

the region, for example, decided against a 200 unit project for this reason.* Mortgage money was in very short supply.

New workers therefore had to rely on mobile homes, of which there were soon 4,000 to 5,000 in the county. The average mining family in Sweetwater County has 2.2 children, .9 dogs, and .3 cats -- so mobile home living was often cramped and unsatisfactory.**

Overcrowding, the case study team concluded, contributed to increases in alcoholism and mental problems, petty crime, violence, behavioral and educational problems with the children, family fights, and high divorce rates. It also increased fire hazards, caused breakdowns in sanitary and trash collection systems, overloaded public service facilities, and caused excessive burdening of medical care facilities.

Educational and recreational facilities also fell behind. Both local school districts bonded themselves up to the local limit but the accumulated deficit in building facilities rose to $3 million.

Prices rose even faster than the national rates of increase. This put a heavy burden on both newcomers and long-time residents, but especially those residents with fixed incomes and those in service and government employment whose salaries did not go up as fast as industrial wages. Available employment for women did not increase proportionately to total employment. Wives and daughters of the newcomers sought jobs and could not find them.

Crime rates, traffic congestion, and parking problems were increased dramatically. One police agency reported that complaints rose 60 percent in a year.

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*Gilmore and Duff, op. cit., p. 14. The average annual income for Sweetwater miners was (1974) $11,400. Using the home mortgage borrowing power rule used by most mortgage companies (twice annual income) this would indicate mining families with one wage earner could afford a house costing approximately $25,000 or renting for $190-240; typical new housing in the county is said to cost about $34,000 to $43,000 or rent for about $235 monthly.

**According to an unpublished mining company survey, cited in Gilmore and Duff, p. 15.

As the quality of life in the community deteriorated, the impacts on the mining companies were also dramatic. Productivity declined by 25 to 40 percent from 1972 to 1973, and tonnage per shift in the trona mines dropped 60 to 75 percent. Employee turnover rose sharply -- 35 percent in some companies and up to 100 percent in others. In spite of attractive competitive wages, labor supply could not catch up to demand and workers had to be actively recruited from areas as far away as Canada and West Virginia.*

Employment turnover in municipal government also rose sharply since government salaries were not competitive with those of industry. When government pay was increased, municipal budgets were strained but people were still not available. Demands for increased municipal services could not be met. The additional assessed valuation from new homes even at inflated prices did not cover the related demands made on municipal revenues -- this was true even for conventional homes and especially true for mobile homes.

If the growth rate subsides in the near future, these problems will not all be solved; in some cases they will worsen. New public facilities cost more than the community can afford when they must be added quickly. There was about $2,100 increase in bonding capacity in Sweetwater (1973) for each new school child,** but that child also requires school plant expansion costing $5,100 ($40-50 per square foot). If mining operations go into a decline, in the future, the community will be left with heavy investment in facilities it can no longer use, and a debt burden that will be insurmountable.

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* Gilmore and Duff, op. cit., p. 20. Employee turnover is attributed to higher wages in the construction trades plus "quality of life problems besetting the community," based on both observation and survey data.

**Ten percent of assessed valuation (State Constitution).

Several points are worth stressing in considering this case study of a modern boom town:

-- the lack of anticipation of and preparation for the rapid growth;

-- the secondary effect of expansion in some sectors of employment on other employment sectors, and the effect on total population;

-- the short-term failure of the market place to accommodate, and the rapid deterioration of the quality of life in the community;

-- the differential burden placed on some segments of the population; and

-- the impacts on the stimulating industry itself, and the implied constraints on further expansion.

Sweetwater County had not foreseen or prepared for rapid growth despite the fact that domestic and foreign demand for natural soda ash was steadily increasing, and trona mining is concentrated in Wyoming and especially in Sweetwater. The decisions that brought about the sudden growth in employment were made separately in a number of corporations without any communication between the companies themselves or between the companies and the communities which were to be impacted.

An important point to remember in assessing local impacts is that every miner who moves into a community from outside is likely to mean 3.1 new inhabitants. If a new mine opened employing, ultimately, 500 miners, this could mean 1,563 new inhabitants (and of those 510 approximately will be school children). But the new mine is also likely to mean construction workers, additional government employees, school teachers, services and trades people -- possibly 2,363 additional new inhabitants.*

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*See Methodological Note, p. 36.

The twelve-fold increase in construction employment resulted both from the opening of new mines and the construction at the power plant (and resulting secondary construction in the community). State and local employees, which include school teachers, increased in four years by 48 percent. We do not know how many construction workers moved into the county with their families as permanent or temporary residents, but if all of the new mining jobs had been filled by newcomers, 85% with families, this alone would account for 19 percent out of the total 101 percent growth in population. The 952 (estimated) mining families would account for 1,142 children immediately added to school rolls, the population of two to three new elementary schools.

Eight-six percent of the people in Sweetwater County live in two towns, Rock Springs (pop. in 1970, 11,657) and Green River (pop. 4,196). The towns had been gaining in population over the past decade (20 percent and 12.4 percent respectively) although the county itself had lost 8.5 percent of its population -- an example of the continuing centralization in rural areas as larger towns grow at the expense of smaller towns and rural population. Towns of this size cannot generally accommodate rapid growth in population because of the small housing stock and the lack of mortgage money from country banks, which are often reluctant to tie up limited resources in long term loans. Since Rock Springs and Green River had been growing slowly over the decade, there is also likely to have been little underutilized infrastructure. In such cases, quality of life quickly deteriorates from overcrowding, inadequate public services, and congested streets and retail trade facilities.

This deterioration of community environment places a heavier burden on some segments of the population than on others. Those with fixed incomes, par-

ticularly the aged, suffer from rising prices for housing and consumer goods. Wives bear the brunt of overcrowded housing, poor shopping facilities with no parking space, children's behavior problems stemming from crowded schools and non-existent recreation facilities, inadequate waste collection, and too few repair and maintenance workers. Those who need or wish to work find that the number of jobs available to women have not kept pace with the number of newcomers seeking such jobs. It is difficult to establish roots in such communities, and family stability suffers.

As community life becomes less acceptable, and at the same time, competition for labor increases, employee turnover rises and productivity declines. Thus the industry whose growth has stimulated the process is in turn impacted by the results of unplanned, unmanaged growth and these impacts can become a significant constraint on further development.

The research team headed by Gilmore and Duff (see footnote, p. 1) concluded the significant lowering of productivity in trona mines in Sweetwater County resulted primarily from excessive employee turnover, which stemmed from two factors: higher rates being paid in the construction industry (where competition for labor resulted both from the expansion of mining employment and construction of a large power plant, and the secondary impacts of these projects on employment growth) and from the deteriorating quality of life in the community. The second factor, unsatisfactory community conditions, they concluded, was of major importance. The pacing parameter for growth management is often the ability of the community to provide housing and the public services which must accompany it. Traditionally housing stock grows at about three percent in large urban areas but only about one percent in rural areas; in West Virginia housing

stock, in the 1960's, expanded at about two percent per year.* When a community is able to anticipate and prepare for a sudden change in its economy, for example a large industrial plant relocating in the area, cooperation between the community and the company can overcome this potential constraint by intervention in the ordinary housing market (for example, local development corporations or company housing, bond issues for new public facilities, mobile classrooms, etc.).

In the absence of such planning and policy interventions, the secondary impacts of sudden economic growth may be sufficiently detrimental to provide a brake on further economic activities, as indicated in the following schematic, Figure 1.

*Interview with Dr. Stephen Fuller, formerly Regional Planner, Appalachian Regional Commission, now consultant to the Commission and Assistant Professor of Urban and Regional Planning, The George Washington University.

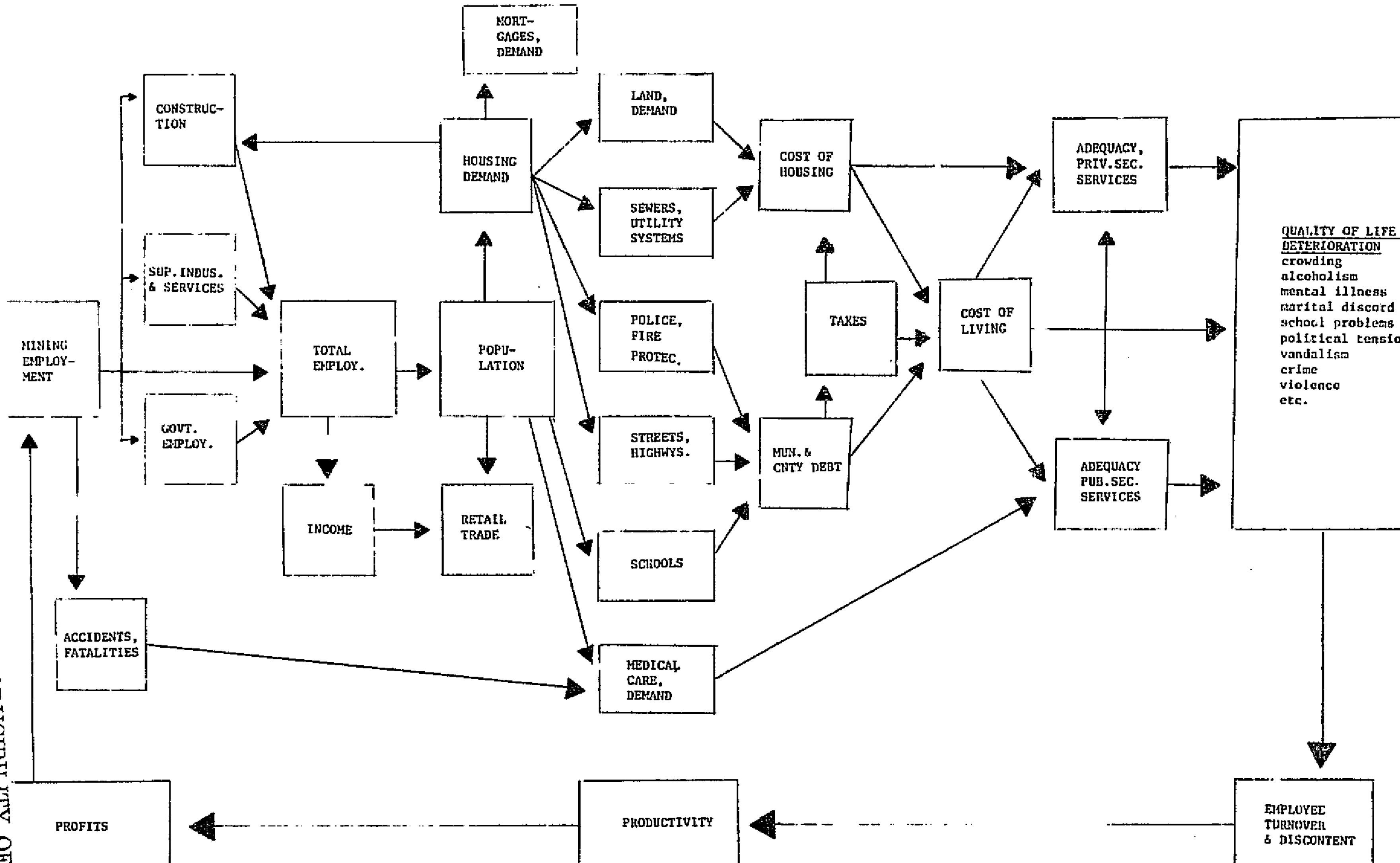

Figure 1: Schematic of Community Impacts -- Rapid Growth V.T.Coates

II. Marion and Monongalia Counties, West Virginia.

In population size and distribution, Marion and Monongalia Counties are very different from Sweetwater County, Wyoming. Large even by western standards, Sweetwater covers 10,429 square miles and had (in 1970) only 18,400 people, for a population density of 2 per square mile. By contrast, Marion County is 1/33 the size (311 square miles) and has over three times as many people (61,400) for a population density of 197 per square mile. Monongalia County has 365 square miles of land and 63,700 people, its density being 175 per square mile. Eighty-six percent of Sweetwater's people live in two communities, Rock Springs (11,657 population) and Green River (4,196). Marion County has, similarly two towns of over 2,500: Fairmont (26,093) and Mannington (2,747) which together account for 47 percent of county residents. Monongalia also has two towns: Morgantown (29,431) and Westover (5,086) which together have 54 percent of county population.*

Thus the West Virginia counties have each about three times as many people as Sweetwater, and about twice as many townspeople. In West Virginia more people live in small hamlets or on farms** and the distance between human settlements is smaller, so that more people can drive to new jobs without changing their place of residence. In Marion and Monongalia Counties, community residents rely on this tendency to discount the community impacts of new mine development -- their immediate response to questions concerning potential

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*Unless otherwise specified, figures in this section are taken from: U.S. Department of Commerce, Bureau of the Census: County and City Data Book, 1972, U.S. Government Printing Office. In most cases, 1970 figures are used for comparison with Sweetwater County, Wyoming, in the last year before its rapid expansion. Later figures are not available in many instances where they would have been desirable.

**In West Virginia, as in most rural areas, farm population has sharply dropped in recent decades; it is now 900 in Marion, and 1,200 in Monongalia, down 54 percent and 44 percent respectively since 1960. Many people continue to live on farms which are no longer productive while working at other jobs. In Sweetwater, only 131 persons were classified as farm population in 1970; the average size farm in Sweetwater is 15,000 acres compared to 100 acres in Marion and Monongalia.

impacts of greater mining employment is (a) that new miners will not move into the community but will drive to work from their present homes in other counties (or the adjacent state), and (b) that "most" of the jobs will be filled in any case by the counties' unemployed.

The TAG research group discounts this factor on several grounds. Commuting to work across county lines is common in many rural West Virginia counties; thus in Doddridge and Taylor Counties (100 percent and 90 percent rural, respectively) adjacent to the study areas, from 28 to 30 percent of workers are employed in other counties, chiefly Marion and Monongalia. However, the available labor force in such counties is small, and should expansion of deep mining occur simultaneously in several adjacent counties or throughout the region, the significance of commuting as a factor will be sharply reduced. Rising prices of gasoline may also reduce the attractiveness of commuting in the future. Overall unemployment rates in the counties have not been high: about four percent in 1970 (compared to Sweetwater's 4.4 percent just prior to the boom) and under six percent in 1975. Moreover, these unemployment figures have limited relevance to mining, since they are inflated somewhat by female unemployment rates (women are seldom employed in the mines although there are now a few, perhaps six, in the two counties), and many of the other unemployed would not be accepted for mining jobs because of health, age, or other factors.

As will be seen in Table I, Marion and Monongalia Counties, although the size of their civilian labor forces is three times that of Sweetwater, are comparable to the Wyoming county in many other ways.

TABLE I

LABOR FORCE
1970

County	Total Employed Labor Force	% in Mining	% Construction	% Manufacturing	%Govt.	% Trade	%Service	%Edu.	%White Collar	% Foremen/ Craftsmen	Female Labor Force
Marion	21,100	16.1	5.5	26.6	13.1	17.7	7.2	7.0	34.6	19.0	7,771
Monongalia	21,900	10.5	6.3	11.9	37.5	15.9	7.1	25.1	49.3	13.4	8,416
Sweetwater	7,000	15.7	7.3	8.1	14.4	20.2	9.9	6.8	40.1	17.6	1,004

The most striking difference is the strong base of manufacturing in Marion County as compared to Sweetwater (and Monongalia). The three largest employers in Marion (a lamp manufacturer, a glass bottle manufacturer, and a power plant) together employ 5,550 people.* Another twelve firms together supply 2,850 jobs. Thus the 8,400 far outweigh the fewer than 3,000 mining jobs in the county. However, approximately half of the industrial jobs are in firms directly tied to mineral industries (a mining equipment manufacturer, a construction firm specializing in coal preparation plants, a second engineering and construction company, the railroad, the power plant).

Approximately 38 percent of the labor force in the West Virginia counties (1970) is female, as contrasted with only 14 percent in Sweetwater. The availability of employment in manufacturing, as well as in government, trade, services, and education may mean that, should mining (and construction) employment increase, wives of newcomers would also have an opportunity to find employment to a greater extent than was the case in Sweetwater. However, there have recently been a number of layoffs in manufacturing plants in the two counties, so that if a national recession prevails there may be little or no gain in female employment opportunities.

Marion and Monongalia Counties had a median family income of $7,800 in 1970 (the U.S. median was then $9,586); 12.8 percent of Marion County's families, and 13.2 percent of Monongalia's, fell below the poverty line in income. Twenty-two percent of Marion County's population, and 13 percent of Monongalians, received either social security payments or old age assistance in 1970; these people would be most hurt by rising prices should a boom in employment and population occur in the area.

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*According to the Industrial Director of Marion County, mme., Chamber of Commerce, 1975.

Sweetwater County was slightly better off in 1970 than the two counties in the study area (see Table II); thus the benefits of increased employment would be slightly greater, but the detrimental impact of inflated housing and consumer costs would also be somewhat greater, in the West Virginia area, should a similar boom occur.

TABLE II

INCOME CHARACTERISTICS

County	Median Fam. Inc.	% families below pov.	Social Sec. Recipients	Old Age Assistance	% Population Rec. S.S. and OAA
Marion	$7,807	12.8%	11,817	306	22%
Monongalia	7,752	13.2%	7,973	214	13%
Sweetwater	9,077	7.6%	2,331	61	13%

Housing stocks in the two counties are shown in Table III. It should be noted that from one-half to two-thirds of the housing is at least thirty-five years old and 8-11 percent lack flush toilets, piped water, or some plumbing facilities. Of the housing units added since 1939, about 16 percent are mobile homes. The price of housing in Sweetwater County rose rapidly under increased demand because of a shortage of developable land, the necessity of new sewage and water treatment facilities, competition for construction labor, and a lack of mortgage money. A glance at Table III shows that the same figures would prevail in West Virginia.

TABLE III

HOUSING STOCK - 1970

Population	Marion County	Monongalia County	Sweetwater County
Total	61,356	63,714	18,391
Rural	32,690	29,241	2,365
Housing Units			
Total	22,264	21,094	6,516
Rural	11,296	10,085	997
Vacant Units			
Total	85	90	9
Rural	79	80	9
Mobile Homes (1974)	850 (3.8%)	1,567 (7.4%)	unknown
Built before 1939	14,996 (67%)	11,327 (54%)	3,918 (60%)
Built before 1949	15,970 (76%)	13,513 (64%)	4,521 (69%)
Lacking Some Plumbing	1,830 (8%)	2,324 (11%)	411 (6%)
No Piped Water	559 (3%)	809 (4%)	147 (2%)
No Flush Toilet	1,261 (6%)	1,643 (8%)	227 (4%)
(With Plumbing)			
Med. Value (owner)	$10,200	$15,500	$15,550
Med. Rent	$ 51	$ 87	$ 65
Public Sewer			
Total	14,641 (66%)	13,448 (64%)	5,774 (89%)
Rural	3,716 (33%)	2,591 (26%)	303 (30%)

Source: U.S. Census, Housing Characteristics, 1970.

It has been estimated that about 15 percent of the land in the two counties is developable for residential and commercial use (because of slope and other topographical features) and about half of that amount is already developed.* This means roughly 50 square miles to accommodate housing, public

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*Hittman Associates.

facilities, and related uses. Marion County lending institutions had $96.5 million in assets in 1970, and Monongalia's had $86.1 million, about half of Sweetwater County's potential savings/population ratio in 1970. There is no branch banking in West Virginia.* At present almost no mortgage money is available except through FHA. Some means is needed for marshalling resources needed for economic development in a region where sudden growth would mean great demands on very limited development funds. There is a shortage of developed industrial sites, and portions of the present industrial base are obsolete.**

About 65 percent of the housing is presently served by public sewer systems. (In Sweetwater County, the figure in 1970 was 89 percent.) Of housing in "rural" areas of the two counties, where new development would presumably occur, only 33 percent (Marion) and 26 percent (Monongalia) are now public sewer systems. Both counties are now facing the necessity of extending their sewer systems. Additional houses in the outlying areas would help to cover the costs of this addition, provided planning is done beforehand as to where development is likely to occur.

There are about 2,417 mobile homes in the two counties. Banks are more willing to make the small, shorter term loans for mobile home purchase than tie up their limited resources in long term mortgages. Mobile homes, however, do not provide sufficient additional tax revenue to cover the municipal and county services which must be provided (according to the Sweetwater County study) and make relatively poor use of limited residential land. Younger miners tend to purchase mobile homes at least during the first five years of employment, deferring conventional home ownership until their families expand and their jobs

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*State Code, §31A-8-12.
**Region VI: Regional Plan.

are more secure. Community leaders reported in many interviews that there would be great resistance in West Virginia -- particularly high-rise apartments which might otherwise be attractive because of land pressures -- because of the value traditionally attached to owning one's own land.

In 1970 there were 11,874 public school children in Marion County and 11,272 in Monongalia. Marion County in 1973 spent $694 per child (projected to be $741 in 1974-75)* and Monongalia spent $836 (average expenditure per child in the State is $910).** Bond issues for schools have several times been defeated in each county; most recently, in April 1975 Marion County voters defeated a bond issue intended for consolidation of seven high schools into three larger high schools to serve the entire county. Most schools in both counties are overcrowded and teacher loads are above national averages. In Monongalia County about 100 high school students are now forced to attend classes in the afternoon or evening because of overcrowding.*

County tax assessors report that 7 percent of county revenue in Marion and 9 percent in Monongalia is derived from property tax on coal mines. The Business and Occupations Tax levied on sales ($3.50 per $100 as applied to coal mines) goes to the State rather than the county, as does the (consumer) sales tax; there is no severance tax applied to coal mining.*** Increased county revenue would therefore result from increased property tax on new mines and on homes, automobiles, utilities, and personal property if mining employment and total population rose significantly.

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*Telephone interviews with E. Jordon, Marion County School System, and with a representative of the Morgantown School Board.
**West Virginia Office of School Statistics, responding to telephone inquiry.
***In Interviews.

"Hard-core" unemployment in the two counties is estimated at about three percent* but is higher in the adjacent rural counties. If general employment increases, there will be an indirect beneficial impact on this problem; while the "hard-core" unemployed (the people with low skills, older persons, the partially disabled) are not eligible for mining jobs they would benefit from expanding secondary employment in low-skill service occupations and from removal from trainable younger workers from these jobs.

In any assessment of community impacts of coal mining, the cumulative impacts of fatalities, injuries, and disease (and the effect of constant awareness of this danger) should be considered. In 1972 and 1973, fatalities per million man-hours from underground coal mining averaged .57** Disabling injuries average 40.92 per million man-hours.*** In West Virginia, as of September 1972, 11.8 percent of working coal miners were found to have simple pneumonoconiosis and 1.3 percent to have the much more serious "complicated category" of the respiratory disease (commonly called "black lung")**** Thus with an average of 5,760 miners employed (1970-1973), Marion and Monongalia might expect 6 fatalities per year from accidents in the mine, 453 men disabled, 680 miners with simple pneumonoconiosis and 75 with a serious version of the disease (those workers already retired or disabled are not included).*****

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*Interviews.

**Coal Age, February 1974, p.83.

***Coal Miners and The Economy, AUMWA Research Report, Sept. 30, 1974, p.13.

****Coal Age, July 1973, p.145.

*****At an average of 240 days per year, eight hours per day, for 5,760 miners.

For purposes of illustrating more quantifiable impacts of expanded coal mining in Marion and Monongalia County, two scenarios are presented below, the first based on a 60% increase in mining employment over a ten year period (5 percent growth per year), the second based on a doubling of mining employment over ten years (7.5 percent growth per year).

TABLE IV

COMMUNITY IMPACTS

A. Assuming 5% growth per year in mining employment, for 10 years.

Impact	Base	1st yr.	After 5 yrs.	After 10 yrs.
Mining Employment	5,760 (av.1970-73)	288 new miners (+ 5%)	1,590 new miners (+27.6%)	3,620 new miners (+62.8%)
Resulting Pop.Growth(1)	125,070 (est.1974)(2)	893 (+0.7%)	4,929 (+3.9%)	11,222 (+9%
Other Employment(3)	26,320 (1973)	552 (+2%)	3,339 (+12.7%)	7,602 (+28.9%)
Resulting Pop.Growth(4)	125,070 (1974)	1,270 (+1%)	7,680 (+6.1%)	17,485 (+14%)
Total Pop. Growth(5)	125,070 (1974)	2,163 (+1.7%)	12,609 (+10%).	28,707 (23%)
No. of New School Children(6)	22,449 (1970)	625 (+2.8%)	3,625 (+16%)	8,193 (+36.5%)
New Schools(7)		1+	7	16
Housing(8)	40,000	521	3,622	6,878
Mobile Homes(9)	2,417 (1973)	+172= 2,589	+1,006= 3,423	+2,290= 4,707
Fatalities (1 yr)	6	7	8	10
Disabled (1 yr)	453 men	475	577	737
Pneum., Complicated	75	79	96	122

TABLE IV (Cont'd)

B. Assuming 7.5% growth per year in mining employment, for 10 years.

Impact	Base	1st yr.	After 5 yrs.	After 10 yrs.
Mining Employment	5,760 (av.1970-73)	432 new miners (+7.5%)	2,509 new miners (+44%)	6,111 new miners (+106%)
Resulting Pop.Growth(1)	125,070 (est.1974)(2)	1,339 (+1%)	7,778 (+6.2%)	18,944 (15.1%)
Other Employment(3)	26,320 (1973)	907 (+3.4%)	5,269 (+20%)	12,833 (+48.8%)
Resulting Pop.Growth(4)	125,070 (est.1974)	2,086 (+1.7%)	12,118 (+9.7%)	29,516 (24%)
Total Pop. Growth(5)	125,070 (est.1974)	3,425 (+2.7%)	19,896 (+15.9%)	48,460 (+39%)
No. of New School Children(6)	22,449 (1974 est.)	985 (+4.4%)	5,720 (+25%)	13,933 (62%)
New Schools(7)		1-2	11	27-28
Housing(8)	40,000 (1974)	921 (+2%)	4,768 (+11.9%)	11,611 (+29%)
Mobile Homes(9)	2,417 (1973)	+274= 2,691	+1,589= 4,006	+3.870= 6,287
Fatalities(1 yr)(10)	6	7	9	13
Disabled (1 yr)	453 men	486	650	933
Pneum., Complicated	75	82	108	154

[Footnotes, page 24]

(1) Latest population figures from 1970 but used for illustrative purposes.
(2) Assuming 85% of new miners have families, with an average of 3.5 persons per family unit; 15% with no dependents, in temporary quarters or drawn from families already living in the area; hence 3.1 new inhabitants per miner.
(3) Growth in other employment estimated at ratio of 2.1 additional jobs per miner. Service (all non-basic) employment to basic employment is actually 3.14 and 2.88 in the two counties (Hittman Associates figures).
(4) Non-basic industry employees estimated at 50% family heads (average 3.5 persons per family), 50% single and living in temporary quarters or drawn from families already living in area; hence 2.3 additional residents per employee.
(5) Addition of (2) and (3) above.
(6) Assuming an average of 1.2 school children per family unit (following Gilmore and Duff, op. cit.); see (2) and (4) above.
(7) Estimated at 500 children per school.
(8) Based solely on families, see (2) and (4) above; baseline of 40,000 units represents 1974 stock minus units dilapidated or with no plumbing.
(9) One-third of new units assumed to be mobile homes, the current trend in the two counties according to Hittman Associates. Second number is new mobile homes added to 1973 baseline.

(10) Fatalities are estimated at .57 per million man-hours, disabling accidents at 40.92 per million man-hours (see p. 21). Man-hours estimated at 240 8-hour days per year (Bureau of Mines). Figures represent annual estimate for last year of period given (1st year, 5th year, 10th year) and are not cumulative. Pneumonoconiosis, complicated, estimated at 1.3% of employed miners (see p. 21).

Marion and Monongalia Counties are relatively well supplied with the transportation needed for growth, since new highways are already nearing completion. However, within the cities of Fairmont and Morgantown, and in many parts of the counties which might be developed, secondary roads are narrow, mountainous and poorly maintained. A large "people mover" is under construction in Morgantown with Federal demonstration funds (primarily to carry students from an outlying campus of the University of West Virginia to the downtown campus, a distance of seven miles). The justification for this project was the congestion at some hours over the narrow, winding road linking the two campuses. Within the cities, streets are narrow and parking will be a serious problem if large scale growth occurs; as already noted, land for additional shopping areas will be limited and expensive.

In terms of the impact of coal expansion on local transportation systems the potential damage of increased coal haulage may or may not be a serious problem nationwide. The West Virginia Highway Department maintains a 60,800 lb. maximum load level for anything hauled by truck in the state. The department indicated that it was not having any problems with excessive haulage on the part of coal companies in the area. Approximately 5% of all state-wide road maintenance is a result of coal traffic.* (Highways in the state of West Virginia are all maintained by the state.)

Overweight hauls must receive prior state approval and the West Virginia highway department maintains a force of inspectors to prevent violation of this regulation. However, there are many night-time violators who load up their trucks after the state inspectors have ended their work day and travel the state roads with overweight cargoes. In the state of West Virginia this has been a problem more serious with the oil well, natural gas, and timber industries,** than with coal, because of the highly transient nature of their business. Coal mining operators are more apt to obey state haulage regulations so as to continue to enjoy good relations with the state regulatory agencies. The state highway commission has the legal authority to shut down any mine found to be hauling coal in excess of the legal limit, without an authorized permit to do so.***

Excessive haulage tends to be a greater problem in the Eastern Kentucky coal areas. In their desire to produce extra tons of coal at a minimum of transportation cost, many Eastern Kentucky coal operators haul in excess of the legal limit.****

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*E. D. Keesing, W. Va. Highway Dept., Asst. Dir., Maintenance.

**<u>Ibid</u>.

***<u>Ibid</u>.

****<u>Ibid</u>.

Expansion of underground coal may not present a problem for the state of West Virginia in terms of an overtaxation of its road system. Almost all of the long distance movement of coal is done by rail or barge, with truck traffic accounting mainly for the transfer of coal from the mine mouth to either rail head or barge landing site. The dependence upon barge systems as the major form of coal haulage is expected to continue, but the "locks" serving barges may become a serious constraint.

County Commissioners, businessmen, regional planners, coal miners, and other community representatives in the study area who were interviewed almost without exception dismiss the possibility of significant expansion of underground coal mining within the two counties. They do not believe that demand for coal will rise sufficiently to make it economically feasible to develop the lower grade veins which have not already been developed. They also say that new mines would be too far from the river for barge transportation, and developing new rail spurs adds to the cost of the coal. On the other hand, when asked to address the question of potential community impacts of expanded coal mining, community representatives generally think only of the beneficial effects of additional employment and income within the community.

Whether or not such opinions as to the feasibility of expansion are valid, it is clear that if expansion did occur, the community would be unprepared for it, and hence unable to manage the resulting growth so as to minimize disruptive consequences to the community. If significant development is to occur steps should be taken to set up lines of communication between mining companies and community leadership, so that the State and the counties and their municipalities can prepare for growth. Emphasis should be placed on encouraging the maintenance of a balanced, diversified economic development as a buffer against the

possibility of a sudden downturn in mining after a period of growth, and as a way of spreading the benefits of growth over other segments of the community as well as those directly involved in mining. For this to happen, ways of channeling development funds and investment money into the community are needed. Housing and land use planning and regulation will be needed. Phased development of additional public service systems, schools, recreation facilities, medical facilities, and industrial sites should be planned in advance, and the mineral industry should be forced to take some responsibility for helping the community to meet the additional demands on it without incurring a disasterous debt burden.

Table V presents a list of potentially affected parties and participants at the local level, based on the analysis of Marion and Monongalia Counties and Sweetwater County. In Table V, X denotes those who will make the original decision to expand coal mining. Y denotes those who will be forced to respond to such decisions by providing additional services, products, and facilities, or who will in the ordinary course of events respond by adjusting their actions (businessmen) or political stances (interest groups). Z denotes those who will be affected involuntarily, e.g., by rising prices, competition, or expanded opportunities. The active, anticipatory participation in the decision process of those denoted Y is particularly desirable in order to manage community growth. The extent to which real and potential impacts in these three counties are generalizable to counties across the nation where future coal development would occur, is a subject needing further study but is beyond the assignment given to TAG.

TABLE V

Potentially Affected Parties and Participants at the Local Level

Coal Mines and Companies	(X)
Managers	(Y)
Union Miners	(Y)
Non-Union Miners	(Z)
Construction Companies	(Y)
Construction Workers	(Z)
Supporting Industry (Mine Equipment, etc.)	(Y)
Trade, Service, and Government Employers and Employees	(Y)
Local Businessmen	(Y)
Medical and Mental Health Delivery Systems	(Y)
School Systems	(Y)
Housing Industry	(Y)
Public Service Systems and Utilities	(Y)
Land Owners	(Y)
County and Municipal Systems: Revenue and Expenditures, Employment, etc. Elected Officials, Government Administratory	(Y)
Regional, State, and Local Planners	(Y)
Investment and Lending Institutions	(Y)
Citizen and Public Interest Groups	(Y)
Families of Miners	(Z)
Residents, Especially those on Fixed Incomes, Consumers	(Z)
Hard-core Unemployed	(Z)

X = Actors, Decisionmakers

Y = Responders (Participants)

Z = Non-voluntary Affected Parties

III. Policy Implications.

Consideration of potential community-level impacts of expanding deep coal mining suggests an area where policy intervention may be in order to modify and control detrimental societal consequences from a change in the level of utilization of a technology. Intervention options include, at the first stage:

1. Establishment of communication mechanisms between local governments and coal companies in localities where coal reserves exist. The purpose of the communication channel is to provide early warning when one or several coal companies plan significant expansion in the area, so that the community has time to plan for growth. A cooperative Community Development Board or committee including representatives of mining companies; other industrial, financial, and commercial interests; local governments; and public interest groups could then prepare strategies for meeting anticipated community needs.

2. A national integrated planning mechanism (either for the coal industry or for all energy source industries) at the Federal level, to identify areas where extensive development is possible and to plan such development in orderly, staged phases with prior attention to materials stockpiling and environmental protection.

If adverse economic, social, and environmental effects of expanded domestic resource exploitation are to be controlled and modified, integrated planning methods must be developed; however, such long range planning at either the local, the regional, or the national level itself implies significant societal consequences which call for prior assessment. Only one aspect of the policy intervention option suggested above has been considered by the research team in the present effort: possible conflict with existing anti-trust legislation and policies. The conflict between anti-trust policy and

energy/environmental concerns has been recognized but remains as yet unresolved.*

Federal anti-trust laws are based on the policy that the public interest is best served by promotion of free and vigorous competition in the market place; they were enacted to prohibit restraints on that competition. The Sherman Act of 1890 (15 U.S.C. Sec. 1-7 (1970)) provides:

> Section 1. Every contract, combination in the form of trust or otherwise, or conspiracy, in restraint of trade or commerce among the several States or with foreign nations, is hereby declared to be illegal....
>
> Section 2. Every person who shall monopolize, or attempt to monopolize, or combine or conspire with any other person or persons to monopolize any part of the trade or commerce among the several States, or with foreign nations, shall be deemed guilty of a misdemeanor....

Section 1 makes illegal <u>any</u> agreement in restraint of trade regardless of the intent of the parties or the public benefit arising from the agreement, because such concerted action creates market power which acts in restraint of competition. Section 2 prohibits "monopolizing" and conspiracies or combinations to monopolize. Monopolizing is not the mere possession of a monopoly, rather "it implies a positive drive apart from sheer competitive skills to seize and exert power in the market."** Intent is the key to violations of Section 2 and such intent is seen in the use or acquisition of market power or dominance, to enhance prices or exclude competitors.

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*See Rowe,"Antitrust Policies and Environmental Controls,"29 <u>Business Lawyer</u> 897 (April 1974); Blumberg, "Corporate Responsibility and the Environment," VIII <u>The Conference Board Record</u> 42 (1971) reprinted in Blumberg, <u>Corporate Responsibility in a Changing Society</u> (1972).

**Neale, <u>The Antitrust Laws of the U.S.A.</u>, at 92-94 (1970).

When viewed against the background of Federal anti-trust laws, therefore, several aspects of the suggested policy options raise questions of legality:

a. The sharing of business information relating to the expansion of employment and/or coal production with (i) local communities and (ii) other coal companies or "the coal industry";

b. The agreement between competitors over aspects of coal development and production locally and nationally.

The determination of the lawfulness of such an arrangement for implementing methods of integrated planning in the coal industry also rests on the degree of economic concentration and vertical integration of the coal industry and the effects and degree of governmental participation in such planning.

Although free and vigorous competition is supposed to be enhanced by the availability of accurate information on business conditions, modern enterprises depend for competitive advantage on secrecy and confidentiality rather than on an open exchange of information. While the anti-trust laws do not forbid the collection and dissemination of business data, the use of such data to control prices or output is illegal.* Even where the information is not used to set price or production, the exchange of business information between competitors may yield an unfair competitive edge to the firms sharing the information and constitute an agreement in restraint of trade.

However, an individual company may communicate with the local governments about its plans for expansion and may agree with the community on a plan for development which would promote the quality of life in the community without any anti-trust problem. It is less clear whether communications between companies when made through participation with local governments are also free

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*See Sugar Institute v. United States, 297 U.S. 553 (1936); Maple Flooring Mfgr's Ass'n v. United States, 268 U.S. 563 (1925).

of anti-trust problems. Where only general information relevant to planning and no anti-competitive activities or practices are involved, joint industry and governmental consultation does not violate anti-trust prohibitions. In fact, as a result of environmental legislation, some cooperative planning involving local communities and industry has been encouraged by state and Federal governments.* Industry-wide sharing of plans for expanded mining activities is not forbidden by the anti-trust laws; indeed a great deal of information about company activities is already made public through press releases, trade publications, annual reports and other public documents. The true relevance of the sharing of business information among competitors to anti-trust laws is the use which the companies make of the information.

The primary anti-trust problem of the proposed intervention lies in the agreement between competing firms on a plan for the orderly development of coal deposits so as to minimize the adverse impacts on the communities involved, and to make a concerted response to the economic, social and environmental problems. If this agreement were to control the locations and rates of expansion of coal industry increases in employment and production, it would have an ultimate influence on the output of the coal industry, the amount of coal entering the market and the market price, and would be an agreement in restraint of trade and illegal under Section 1 of the Sherman Act. The problem of an agreement in restraint of trade arises also when more than one business entity agrees with another or another person to control or limit its economic activity.

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*See Federal Water Pollution Control Act of 1972, 33 U.S.C. §1251(a)(1) and Clean Air Act, 33 U.S.C. §1316.

Although the industry and the coal companies were entering into the agreement for integrated development with the cooperation of and for the benefit of the small communities which would be disrupted by disorderly expansion, these localities could not offer immunity from anti-trust laws. The good intentions of the parties and the social benefit to be gained by such agreement are no defense to the illegality of the action in restraint of trade. In some regulated industries, such an agreement could be upheld, even though it is anti-competitive in nature, if the regulatory body charged with the authority to weigh the broader public interests to be served against the effects on competition determined that orderly development of coal deposits was the more important public interest. But the coal industry is not so regulated and without specific statutory exemption, the agreement must fail. The era of cooperative integrated planning between industry and local governments must await Federal action on the implications for national anti-trust policy.

The coal industry has a high degree of economic concentration. A small number of companies control a major portion of the supply and market for coal and coal products such as coke. In addition many of the coal companies are vertically integrated so that a single corporate entity controls the coal from mine to ultimate purchaser. With such an oligopolistic structure, any agreement or course of concerted action among coal companies may also lead to violations of Section 2 of the Sherman Act. In determining whether such violations might arise out of adoption of an agreement between major producers or industry-wide, the use of the market power created in the agreement as well as the intent of the parties would be examined. If the participating companies used the information obtained through the agreement and/or the development plan

in the agreement itself as the means to exert market power by controlling or influencing the flow of coal to the market or its price or to exclude competitors, the requisite intent for violations of Section 2 would probably be demonstrated by the course of conduct of the firms so charged. The planning agreement might also be used to set up exclusive rights of development between companies operating in different or the same locations. The potential for anti-competitive abuse is apparent.

What, then, can the mining companies do to promote integrated planning for expansion of mining activities in cooperation with local governments?

Without running afoul of the anti-trust laws, they can cooperate on an individual basis with local governments and encourage industry-wide cooperation with local governments. They can communicate their plans for expanded activities to the localities directly or through media facilities and encourage others in the industry to do likewise. They can seek Federal review of development agreements between more than one coal company and a locality in the appropriate agency if Federal agency action is involved in the development or by seeking an opinion from the Department of Justice in a formal Business Review Procedure which would provide some limited protection. They can seek the establishment of a government-regulated procedure for the adoption and implementation for such integrated planning agreements.*

If, as predicted in this partial technology assessment, detrimental impacts on local communities of rapidly expanded deep coal mining production

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*Blumberg, supra. One of the frequent concerns voiced in his article was that firms that sought to deal effectively with environmental concerns would be placed at a competitive disadvantage with those firms which neglected such responsibilities, the result of these fears would be that firms would pressure the government to regulate appropriate corporate responses through law.

are sufficiently serious to constitute an eventual constraint on further expansion because of their effects on productivity, coal mining companies and the electric power companies which depend on their output should consider the advantages to themselves of actively encouraging such voluntary communication and cooperation within the restraints imposed by present anti-trust legislation. At a higher level and in a more long-range context, the Federal Energy Administration could after more extensive analysis contemplate proposal to the U.S. Congress of appropriate modifications of anti-trust legislation and establishment of an information and planning mechanism at the Federal level. This action could be considered in connection with the establishment of a National Materials Information System, now being studied under the auspices of the Office of Technology Assessment, U.S. Congress. Policy analysis of the proposed interventions could also be initiated by the House or Senate Committee on the Interior and Insular Affairs, by request to the Office of Technology Assessment.

V. CASE STUDIES

F. An Integrated Strategy for Aircraft/Airport Noise Abatement: A Legal-Institutional Analysis of §7 of the Noise Control Act of 1972 and Proposals Based Thereon

Louis H. MAYO

September 1973 (Abstract of Report)

ABSTRACT OF REPORT

The aircraft/airport noise problem has reached its present--and socially unacceptable--dimension as a result of several conditions: the reluctance of the Federal Aviation Administration to give adequate attention to aircraft/airport noise, this environmental intrusion being considered to date as a mere "side-effect" to the FAA responsibility to promote a national system of safe and efficient air transportation; the tardy, piecemeal efforts of the Congress in confronting the problem prior to 1972, preferring previously to deal with the situation on a partial §611 "source" control basis rather than as a total social problem context involving a coordinated inter-Federal as well as a Federal-State-Local-Private Sector effort; the uncertainty, both real and professed, of the "control structure" concerning who has the authority to do what with respect to aircraft/airport noise abatement; the deficiencies of "acoustical science" to provide convincing and reliable "demonstrable data" on the magnitude of the adverse effects of noise on people and social activities; and the relatively recent emergence of a social sensitivity to noise as a serious environmental intrusion rather than a necessary or mere incidental "externality" of a progressive, industrialized society. These conditions have produced a situation in which noise-abused citizens have been forced to initiate judicial remedial actions in order to generate a minimum effort on the part of responsible governmental entities. Further, the lack of both useful data of the effects of noise and viable legal theories has inhibited the effectiveness of this <u>reactive ap-</u>

proach to aircraft/airport noise abatement although the resources are now being marshalled which could result in substantial liability to some airport proprietors unless an effective strategy of noise abatement is promptly initiated. It is generally agreed, however, that the judicial approach is not a suitable means for bringing airport operations into compatibility with other community activities and social interests.

The crucial deficiency with the existing legal/institutional control structure is that there has been no integrated approach to the problem of aircraft/airport noise abatement. There has been no inclusive governmental effort to identify the effects of noise, to establish "public health and welfare" goals for the elimination or reduction of detrimental effects, and to align noise abatement tasks with governmental entities at all levels having the social mission interest, the formal authority, the professional capabilities, and other existing resources to execute the required tasks in a co-ordinated manner. Instead, the general disposition of responsible or potentially responsible public and private sector entities producing, regulating, or otherwise affected by aircraft/airport noise has been to evade rather than confront the problem. This has led to a practice of each entity acting in isolation rather than in co-ordination in order to protect itself from liability, additional administrative duties, or other real or imagined burdens.

The Griggs case, decided by the Supreme Court in 1962, which placed liability for aircraft noise harm on the airport operator, thereby immunizing both the Federal government and the air carriers, has been a primary contributor to the inadequacy of the aircraft noise regulatory scheme. The Griggs "legal solution" produced

habits of thought and patterns of behavior among the major participants in the aircraft/airport noise context which have effectively precluded a constructive goals-means, social problem approach. Not until passage of the Noise Control Act of 1972 was there even a statutory framework which could accommodate systematic development of an integrated aircraft/airport noise abatement strategy.

As of this time, the most critical existing conditions emerge from the interactions of the statutory mandate of the Noise Control Act of 1972 to bring environmental noise levels into compatibility with the "public health and welfare," the 1973 Burbank case ruling of full Federal preemption over aircraft noise, and the lingering liability for aircraft/airport noise imposed on the airport operator by Griggs. The EPA is obligated to establish the "public health and welfare" goal and the FAA is responsible for promulgating appropriate regulations for the control of aircraft/airport noise, but the airport operator is still left with current and continuing responsibility for noise harm under the Griggs doctrine. Surely, a recognized principle of social justice is the acceptance of commensurate responsibility (whether in terms of accountability or liability) with the scope of formal authority conferred on and asserted by a given entity or level of government. The majority opinion in Burbank observed that it is the "pervasive nature of the scheme of federal regulation of aircraft noise that leads us to conclude that there is preemption."

Among the basic Findings and Conclusions of this Report are the following:

A. Federal control by the EPA and FAA over aircraft/airport noise is pervasive as found by the Supreme Court in Burbank, based

largely on §7 of the Noise Control Act of 1972, which includes a revised §611 of the Federal Aviation Act of 1958 requiring the introduction by EPA of "public health and welfare" considerations into the FAA §611 aircraft noise regulatory process.

B. The essentially complete Federal preemption of control over aircraft/airport noise necessarily implies, in terms of responsible public administration, that the Federal government initiate the required administrative and legislative actions to design and implement an integrated aircraft/airport noise abatement strategy. This initiative involves the alignment of authority with responsibility with skill capabilities and with financial resources for effective implementation of the Noise Control Act of 1972/§5(a)(2) "public health and welfare" goals.

C. The most promising legal/institutional instrument for the design, implementation, and operation of an effective aircraft/airport noise regulatory scheme in the near time is the device of <u>airport certification for noise</u> pursuant to §611 and §612 of the Federal Aviation Act of 1958 and §5 and §7 of the Noise Control Act of 1972. Major advantages in this admittedly complicated approach include: 1) recognition both that there exists a national air transportation system which requires a high degree of uniformity in regulation, and that each particular airport requires a somewhat unique approach to its noise abatement task; 2) opportunity for all of the principal participants affecting or affected by the aircraft/airport noise situation to contribute to the design and implementation of airport noise abatement plans pursuant to the certification process; and 3) provision for all noise abatement techniques (technological, operational, and land use management) to be applied in

a systematic, articulated manner to the noise abatement task.

D. It is incumbent upon the FAA, in cooperation with EPA, 1) to provide airport proprietors with reliable data on intended or prospective technological and operational abatement actions as essential inputs into airport noise abatement plans; and 2) to implement proposed technological and operational abatement actions in timely and effective fashion so as to enable airport proprietors to come into compliance with EPA §5(a)(2) "public health and welfare" goals at the earliest practicable date.

E. There now exists no coordinated system of revenue sources and funding mechanisms directed explicitly to aircraft/airport noise abatement. Such a system must be a parallel action to that of the EPA FAA §7 aircraft/airport noise regulatory process. Initiation and coordination must be located at the Federal level so as to bring the responsibility for aircraft/airport noise abatement into alignment with the authority for abatement which is now lodged, per Burbank, in the EPA and the FAA.

F. A primary consideration in achieving the public health and welfare goal in airport noise environments is to effect a reallocation of the "social costs" of aircraft/airport noise so as to place the burden of abatement costs on the user/beneficiaries of air transportation and thereby relieve noise-exposed non-beneficiaries who now suffer this social cost--harm to public health and welfare. This is the first level of social justice concern.

G. The secondary objective is to allocate the costs among the user/beneficiaries of air transportation and, insofar as feasible, in proportion to the degree of benefit derived. This is the second

level of social justice concern.

The primary Recommendations of this Report are based upon and directly related to the foregoing Conclusions. The focal point of the entire scheme of recommendations is the imposition of a "public health and welfare" noise level requirement as a condition to airport operating certification. Most of the recommendations are proposed for reason that they in some manner provide the necessary formal authority for or contribute to the efficiency and quality of the process of developing airport noise abatement plans.

The recommendations also reflect a dominant Federal role in the implementation of an integrated aircraft/airport noise abatement strategy. This role involves not only authority but the acceptance of a commensurate responsibility to provide the essential resources to implement the mandate of the Noise Control Act of 1972. However, the recommendations also make clear that States, municipalities, non-airport owners but affected jurisdictions, airport proprietors, and innumerable private sector entities have indispensable functions in the implementation of an integrated noise abatement program.

The capability for the promulgation and implementation of aircraft/airport noise standards requires not only a legal mandate but adequate administrative and financial resources. Though the Burbank opinion disclaims knowledge of the "ultimate remedy for aircraft noise which plagues many communities and tens of thousands of people," it obviously makes little sense to have the authority lodged at the Federal level with other essential resources to be supplied at the State/local level. This is essentially the mis-

alignment between legal authority, political and social capability, and financial resources which has negated effective noise abatement efforts since Griggs. This misalignment of legal authority and implementation resources can be corrected only by Federal level action. It would seem incumbent upon the Congress, commensurate with the authority lodged at the Federal level, to provide the abatement implementation resources which are beyond the ability of State or municipal airport owners or of airport proprietors to assemble.

The recommendations made with respect to the funding of an integrated aircraft/airport noise abatement strategy recognize the need for new or expanded versions of existing funding arrangements and mechanisms for the collection of revenues from appropriate sources and the disbursement to designated abatement action entities (public or private) in a systematic and equitable manner. It is stressed that such funding programs should make maximum use of existing revenue sources and mechanisms in order to simplify and expedite implementation of essential abatement actions. In this connection it is recommended that the Airport and Airway Development Act of 1970 be amended to: 1) provide explicitly for grants for noise abatement purposes; 2) require that approval of ADAP grants for whatever purpose be conditioned upon adequate consideration of noise effects in addition to air and water quality; and 3) that the "sponsor" category be enlarged to include "adjacent non-airport owner jurisdictions" and relevant private sector entities. It is also recommended that the tax on sources of revenue now provided in the Airport and Airway Revenue Act of 1970 be increased so as to bring the Airport and Airway Trust Fund resources to a level commensurate

with the Federal responsibility to contribute effectively to the implementation of an integrated aircraft/airport noise abatement strategy.